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The CANADIAN FIELD-NATURALIST

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FOUNDED IN 1879

The objects of the club are to foster an acquaintance with and a love of nature, to encourage investigation and to publish the results of original research and observations in all branches of natural history. The patrons are Their Excellencies the Governor General and Madame Vanier. The club is a corporate member of the Federation of Ontario Naturalists.

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A GUIDE TO THE GEOLOGY OF THE GATINEAU-LIEVRE DISTRICT

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INTRODUCTION

The Gatineau-Lièvre district has much to offer to the person interested in earth science. For the naturalist there is the origin of such scenic features as the Eardley escarpment, the Ottawa plain and the Meach Lake Valley. Mineral collectors the world over regard the area as a source of showcase minerals. Petrologists delight in discussing the nature of the ancient rocks and the problems of establishing their origin. This guide attempts to combine all three interests.

In the past it was difficult to examine some of the occurrences because they were small and widely spaced, but new quarries and roadcuts now present some excellent localities. Recent construction of the Gatineau Parkway has exposed a fine section of the rocks and given an opportune development for the undertaking of this guidebook.

Excursion stops are easily accessible. All fall within a 30-mile radius of the city of Ottawa. Most can be approached from paved roads and the maximum walking distance is about ½ mile. Mileages have been clocked from Baillot and Laurier streets in Hull, a mile from the cenotaph. Time and space do not permit coverage of field trips in the area, which includes McGregor and Donaldson lakes, a suitable area for future guidebooks.

Geological data for this region are obtainable from several publications. No reports on the southern part of the Gatineau region other than those of reconnaissance surveys by Vennor (1878)* and Ells (1901), have been published. The Buckingham region has been mapped by M. E. Wilson (1920) and the Wakefield area by Béland (1954). A brief guide to the geology of the Gatineau-Lièvre region was issued by Stansfield (1913) for excursion A8 of the twelfth session of the International Geological Congress.

ACKNOWLEDGMENTS

The manuscript was read by Professors D. M. Baird and D. L. Dineley of the University of Ottawa, Dr. A. S. MacLaren of the Geological Survey of Canada and Mr. V. McBride, Editorial and Information Division, Department of Mines and Technical Surveys, Dr. N. R. Gadd of the Geological Survey of Canada and Professor Baird accompanied the writer to several of the excursion localities and contributed much through stimulating discussions. Many minerals were identified by X-ray diffraction at the Geological Survey

*References are listed at the end of Part Three.

Mailing date of this number: March 2, 1962

by Miss A. P. Sabina. Mr. R. F. Dore of the National Capital Commission supplied road plans of the Gatineau Parkway and Major S. F. Dadson of the Army Survey Establishment prepared the print that was used as a base for the location map. Colour photographs, loaned by Mr. C. Tanner of the Aluminum Company of Canada, were helpful in constructing a geological cross-section of the Maxwell quarry (Figure 22). Most of the photographs used here were printed by Miss A. McCain of the National Museum of Canada or by Professor Baird. The project was suggested by Dr. L. S. Russell of the National Museum of Canada. His interest and encouragement are gratefully acknowledged.

Credit for individual illustrations is as follows: H. Finn (draughting), Figures 10, 11, 12, 13 and location map; Professor D. M. Baird, Figures 2, 5, 19, 23, and 28; The Geological Survey of Canada, Figures 7, 8, and 9; The National Museum of Canada, Figures 1, 3, and 4; Mineral Resources Division, Department of Mines and Technical Surveys, Figures 6 and 17.

PART ONE

GEOLOGICAL OUTLINE

History of the Rocks

Rocks of the Gatineau-Lièvre district can be placed in three distinct age categories – Precambrian, Ordovician and Pleistocene. The earliest, Precambrian, consist largely of formations that were once similar to the limestones, shales and sandstones that underlie the city of Ottawa. But they are now metamorphic rocks, having been drastically changed by intense heat and material introduced from invading molten masses. Limestone has been changed to a coarse-grained rock containing new minerals such as forsterite and actinolite (Figures 1 and 2). The formerly important deposits of phosphate and amber mica can be regarded as hybrid products of limestone and the intruding pegmatite. Characteristic minerals include sahlite, apatite, scapolite, and phlogopite (Figures 3 and 4). Shale has been converted to a coarse-grained, banded rock or gneiss (Figure 5). The greenish black layered rock of the Camp Fortune – Black Lake region was once limy shale. Sandstone now appears as sinuous bands of quartzite.

Precambrian igneous rocks are also common in the region. Syenite, a pink or grey rock, is exposed in many roadcuts in the northern part of Gatineau Park. A large mass, predominently composed of syenite, extends from Lac la Pêche for 20 miles towards St. Pierre de Wakefield, and is as much as 10 miles wide. A late phase of the syenite near Meach Lake was found to be 1000 million years old, based on the amount of lead, uranium and thorium in its radioactive minerals. The metamorphic rocks and syenite are commonly crisscrossed by tabular bodies or dykes of coarse pink pegmatite. Still later are black diabase dykes (Figure 6) that are discontinuous but everywhere trend east-west. The diabase does not intersect rocks younger than the Precambrian formations.

Deformation due to great stresses in the earth produced the Laurentian Mountain Range, which millions of years ago extended over much of southern Ontario and Quebec. This was eroded away during the long period before

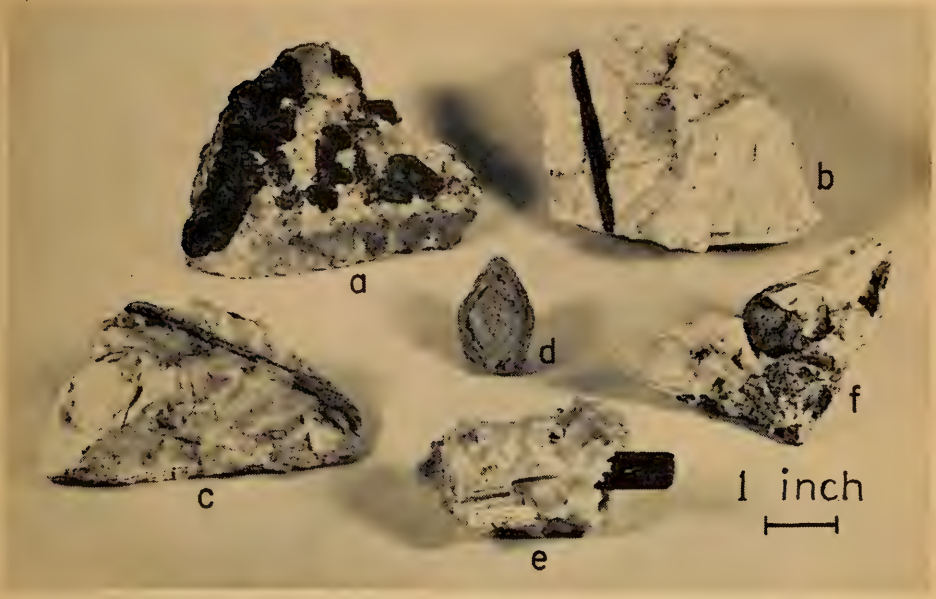


FIGURE 1. Minerals occurring in pegmatite and crystalline limestone: *a*. andradite in quartz (pegmatite, Fortune Lake); *b*. tourmaline in albite (pegmatite, Battle Lake); *c*. thorianite in microcline (pegmatite, Donaldson Lake); *d*. euxenite (pegmatite, Lac Ecluse); *e*. actinolite in calcite (crystalline limestone, Kingsmere); *f*. forsterite in calcite (crystalline limestone, Maxwell quarry).

FIGURE 2. Folded and weathered outcrop of impure crystalline limestone (Masson). Impurities stand up in relief.

FIGURE 3. Minerals occurring in pyroxenite: *a*. apatite in calcite (Old Chelsea); *b*. apatite (Old Chelsea); *c*. sahlite (Limbour); *d*. and *e*. sahlite (Champlain lookout).

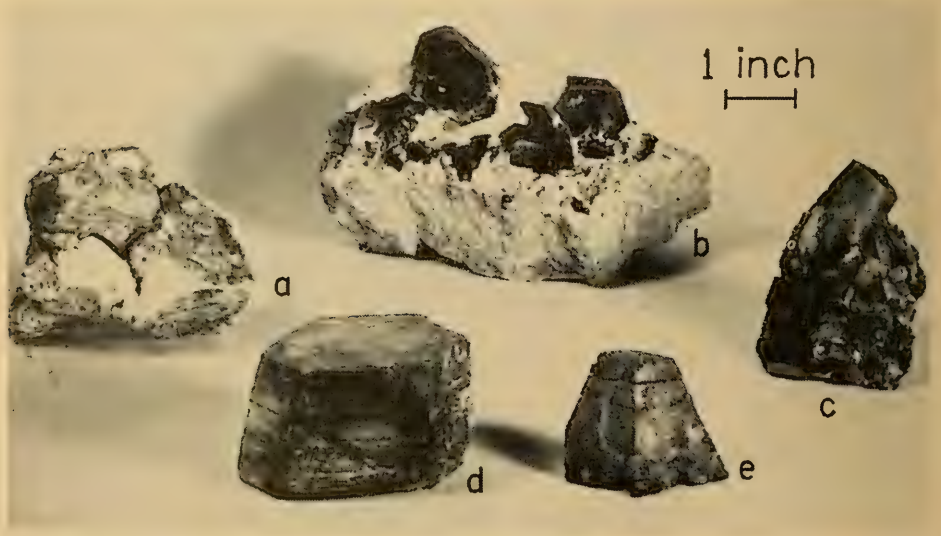


FIGURE 4. Minerals occurring in pyroxenite: *a*. scapolite (Donaldson Lake); *b*. phlogopite in calcite (Perkins); *c*. phlogopite (Limbour); *d*. phlogopite (Headley mine); *e*. phlogopite (Limbour).

FIGURE 5. Typical gneiss showing alternate dark and light layers (Masson).

FIGURE 6. Diabase dykes (Poupore).

the Ordovician rocks were deposited. What remain today are merely stumps of the former mountains. Metamorphic rocks appear to have been squeezed into trough-like folds between granites or syenites.

In the Ordovician period about 450 million years ago, the sea advanced over the region and sediments were deposited on the ocean floor. These sediments were later hardened to make sandstone and limestone. The lowest member of this sequence is the Nepean Sandstone, deposited on an irregular Precambrian surface. Above are limestones of the Beekmantown, Chazy, and Black River – Trenton formations. The Ordovician rocks are exposed as scattered outcrops in creek beds, roadcuts and other places in the Ottawa Valley plain. Geologists believe that a large block of rock that now underlies the valley moved downward along fractures. This block, which contains the Ordovician limestone, has been preserved, while the higher regions have been planed off by agents of erosion such as rainwater, rivers and ice. The northern boundary of the subsided block is the Eardley escarpment, which is as much as 900 feet high and extends as a wall along the edge of the plain. East of the Gatineau River there is no similar topographic boundary.

Some 450 million years elapsed between Ordovician and geologically recent time, and little is known of what happened during this long period. In the Bancroft region to the east, an estimated 5 to 7 miles of rock has been removed since the Precambrian rocks, now at the surface, were formed. The Pleistocene or Ice Age marked the climax of a long interval of erosion.

In comparatively recent time, large quantities of limestone were removed by the solvent action of rainwater. Water, made acidic by dissolved carbon dioxide, percolated through bedding and joint planes in limestone, dissolved some of the surrounding rock and greatly enlarged the original openings. Lusk Cave near Harrington Lake and Laflèche Cavern near Wilson's Corners were formed in this manner.

When the roof of a cave collapsed, a circular depression – known as a sink – became evident at the surface. Some of the sinks were sealed by insoluble material and became filled with water. A narrow limestone band southeast of the Champlain lookout can be traced on aerial photographs as a series of sink lakes and depressions (see Figure 12, page 20).

Dissolved calcium carbonate sometimes redeposited in the cave. As the water collected on the roof, it evaporated, precipitating aragonite or calcite. This deposit developed into a stalactite – an icicle-like structure (see Figure 20, page 33). Additional evaporation after the water has dropped would perhaps form a stalagmite – an inverted 'icicle' – on the floor of the cave. A column formed where a stalagmite and stalactite met.

The Pleistocene Epoch or Ice Age

During the Pleistocene epoch Canada was covered by an immense ice-cap similar to those of Greenland and Antarctica today. Glaciers planed the land and transported rock debris many miles to the south.

Arctic climate prevailed during this interval. However, the Pleistocene was not continuously cold; it included warm interglacial periods. Although

FIGURE 7. Raised beaches (Ste. Rose de Lima).

evidence for these warm periods has not been found near Ottawa, sand that was laid down under temperate conditions has been described from Toronto and other places in North America. According to radiocarbon dating, the final cold period lasted 25,000 years. Permanent snow disappeared about 10,000 years ago.

As the ice-cap melted, the rounded and grooved bedrock began to appear through the snow. Material transported by the glaciers was deposited irregularly as ground moraine. Large isolated boulders may be seen south of Kingsmere Lake. A boulder of Precambrian rock transported from Quebec was discovered in Rockcliffe and is now displayed in front of the National Museum.

Drumlins – hills of glaciated debris moulded by overriding ice – are not common in the Gatineau-Lièvre region; these are most abundant in areas that have been extensively covered by drift. They are oriented parallel to the direction of glacial movement with the steeper sides pointing in the direction of ice-retreat.

Rivers flowing beneath the ice deposited sinuous sand-and-gravel ridges called eskers. These narrow ridges may wind and branch, commonly disregarding topography by climbing hills and descending valleys. An esker north of Quinnville can be traced for about a mile.

During the Pleistocene epoch the burden of ice greatly depressed the land, and the southern Gatineau Valley and adjacent Ottawa River Valley were flooded by sea water as the glaciers withdrew. This sea, the Champlain Sea, advanced to points that have since been elevated to 700 feet above sea-level. Radiocarbon dating indicates that the marine invasion began 11,500 years ago and lasted about 2,000 years.

The extent of the Champlain Sea is shown by shorelines and marine terraces. A well-defined beach (Figure 7) averages 225 feet above sea-level

and can be traced continuously from Ste. Rose de Lima for about 5 miles westward. It reappears on the west side of the Gatineau as a bank 75 feet high, which forms the "Mile Hill" and the Dome Hill ski-slope. Higher terraces are seen at elevations of 440 feet (northwest of Chelsea) and 500 feet (on the east side of the Gatineau River, facing Wakefield).

Marine clay from the Champlain Sea is widespread in the Ottawa district. When interbedded with silt, these clays are particularly susceptible to landslides. Notable is the 1908 landslide (Figure 8) at Notre Dame de la Salette where 6 acres of hillside became dislodged and tumbled into the Lièvre River, causing partial destruction of the village on the opposite bank; 15 houses were completely destroyed and 33 persons lost their lives. Landslides have also occurred along the Gatineau. An example may be seen opposite the village of Limbour where an area of about 110 acres was affected; the wrinkled and hummocky scar extends from the Gatineau across Route 11. A comparable slide occurred on the old-shore cliff of the Champlain Sea a mile east of Ironside.

While the main Ottawa and Gatineau valleys predate the Ice Age, certain valleys owe their origin to glaciers or have been greatly modified by them. Meach Lake appears to have once drained southward through Chelsea Brook. The drainage was later diverted to its present northerly course when the exit at the south end of the lake was dammed by glacial debris. A lump of ice buried in this moraine melted to form the deep hollow or kettle just west of the road approaching Meach Lake. Similar kettles can be seen near Buckingham (Figure 9).

Former deltas are in some places evident from gravel pits. The Gatineau River apparently emptied into the Champlain Sea at a point just east of its present course and 2½ miles northwest of Pointe Gatineau. A former distributary in its central part has exposed the underlying marine clay.

HISTORY OF MINING IN THE REGION

PHOSPHATE (OR APATITE) AND MICA MINES

Mica and apatite were first reported in the area in 1831 by Lieutenant F. L. Ingall, who was in charge of a Royal Commission exploring the region between the St. Maurice and Lièvre rivers. Lieutenant Ingall noted mica and "large quantities" of phosphate on the Lièvre below Lac aux Sables.

Phosphate was not mined until about 1870, the first exports being to England in 1872. By 1877 considerable quantities of apatite were being taken from the Buckingham and Portland districts. In 1890, the peak year, some 29,500 tons was produced, although production from individual mines was small. The largest mine, the High Rock, never produced more than 100 tons of marketable phosphate in a day.

One of the largest of the early phosphate companies was La Société française des Phosphates du Canada, popularly known as "the French Company." It was organized in Paris in 1881, with the equivalent of $500,000 capitalization. Its first action was a $60,000 purchase of all available lots in

FIGURE 8. An old photograph of Salette after the landslide of 1908.

FIGURE 9. A kettle (Buckingham area).

the phosphate district of Portland township. These lots were subsequently sold, the last in May 1890.

Prior to the construction of the Buckingham branch of the Canadian Pacific Railway (1884), phosphate was drawn south by team in winter. The first attempt to use the Lièvre River for transportation was made by the Little Union Phosphate Company in 1883. In September of that year their scow was wrecked at the Little Rapids and the mine operators sought construction of a dam near Poupore. (This does not seem to have been realized until 1888.) Some of the larger properties, such as the High Rock, Little Rapids and Emerald, constructed tramways to the Lièvre. Cars descended by gravity and were drawn up the slope by horses. The Ottawa-Gatineau Railway was opened in 1892.

In 1890 the General Phosphate Corporation Ltd. or "English Company" was formed in London, with £1,000,000 capitalization. This organization's purpose was to acquire all the larger phosphate mines in Canada and thus corner the market. The founders and directors comprised prominent English aristocrats and well-known Canadians including Sir Charles Tupper. Despite the acquisition of such promising properties as the Murphy, Ross Mountain and High Falls mines, the company was badly mismanaged and was never a success. After a series of court investigations, it passed into receivership in 1893.

About this time, companies in Florida began making inroads to the phosphate market and the price of apatite dropped markedly. One after another the phosphate companies were forced to close, and by the fall of 1894 the High Rock was the only producing mine. During World War II many of the old mines were reopened when American imports were curtailed. Among the mines were the Little Union and High Rock of Portland West township. Today no phosphate is mined in the Gatineau-Lièvre district.

Large apatite crystals were sometimes found during active mining. An almost perfect crystal weighing about 700 pounds, was taken from the Emerald mine in 1883. A much larger terminated crystal – measuring 7 feet long and 4 feet wide and estimated to weigh 6 tons – was discovered in the Aetna mine in 1889. An attempt to remove this crystal intact was unsuccessful.

Amber mica or phlogopite was commonly associated with apatite and many of the old phosphate mines were reworked for mica after 1895. At other mica properties, such as the Lac Girard and Parker mines, apatite was very rare and never recovered. Annual production of mica seldom exceeded 1,500 tons for the entire district, but a relatively large proportion was of splitting quality. The principal mica-mining companies were E. Wallingford in Templeton township, Lac Girard in Hull and Wakefield townships, and Blackburn Brothers in Hull and Templeton townships. In recent years, Canadian phlogopite has bowed to the competition of Indian and Madagascar mica, and today the sole operating mill in the Gatineau-Lièvre district is that of Blackburn Brothers.

IRON

Hematite deposits were first noted at what was probably the Haycock mine by John Bigsby in 1825; they were described in a memoir of his works

published in 1827. The deposits, "near Hull", were low in sulphur and contained pyroxene-"coccolite". This description seems to fit the Haycock mine but Bigsby also mentions graphite, which conforms more to the Forsyth mine. The Haycock mine was operated in 1872 and a 6¼-mile aerial tramway to the Gatineau River was constructed in 1873. Iron ore was excavated from numerous small pits but the veins were very narrow and the ore high in titanium. Work was apparently suspended in 1874.

The Forsyth magnetite occurrence has also been known for many years. The deposit was briefly described by Lieutenant Baddeley in 1830 from data submitted by Mr. Burrows, the Overseer of Works on the Rideau. It was not until 1854 that active exploration and development were undertaken by the Forsyth Iron Company. By 1858, a total of 8,000 tons of magnetite ore had been shipped to the company's iron works in Pittsburgh. A blast furnace was erected on the property in 1867 but only operated for 6 months and was dismantled in 1888. Production of ore continued intermittently until 1918.

Iron ore was taken from a number of excavations, the main pit being 730 feet long and as much as 50 feet deep. A shaft was put down 180 feet from the bottom of this pit and connected with a stope 180 feet long and 20 feet wide. Another area of pits (the Baldwin deposit) lies 2,000 feet to the west.

In late 1957 the property was acquired by Hull Iron Mines Ltd. which explored the Forsyth deposit by diamond-drilling and underground work.

GRAPHITE

Graphite has long been known in the Buckingham district. The first mines were south of Lac la Blanche. In the Progress Report of the Geological Survey of Canada for 1863-1866, W. E. Logan notes that the Lochaber Plumbago Company operated a mill on the Blanche River. About this time a number of small prospect pits were excavated near Donaldson Lake, principally by Mr. J. Labouglie of Buckingham.

One of the first active companies near Donaldson Lake was the Canada Plumbago Company (1866). A 20-ton-per-day graphite mill, powered by the creek draining Twin Lakes, was erected in 1867. This became known as the "Castle property," and from 1870 to 1873 it produced graphite from ore mined in the surrounding territory. In 1875 the mill was destroyed by a forest fire.

Another early producer was the Dominion of Canada Plumbago Company, incorporated in England with £100,000 capitalization. Near their largest mine – the "Dome" property 2 miles northeast of Donaldson Lake – a community sprang up which was given the aspiring title of "Graphite City." The village was complete with a barrel-making factory, post office, blacksmith shop, sawmill, boarding houses, and a mill that turned out 15 tons of graphite a week.

These early mills extracted graphite on the principle of its low specific gravity. A slurry of ore was passed into a tank, or buddle, in which the liquid was made to rotate. Graphite, being the lightest constituent of the ore, gradually passed toward the periphery of the tank where it was drawn off as a concentrate.

Some of the later mills of the Donaldson Lake district, such as those of the Dominion and North American mines, employed the quality of brittleness in their extraction. The ore was dried, crushed and ground. The flake graphite was easily screened off from the more brittle and finer waste material (chiefly calcite).

Production was sporadic and rather small. Much of the graphite, however, was the valuable crystalline-foliated variety which was widely used in certain types of crucibles. Columnar graphite was comparatively rare.

Brucite

Brucite was first identified in Canada by M. F. Goudge of the Mines Branch during an investigation of Canadian limestones. The first occurrence was discovered during the summer of 1937 at Rutherglen, Ontario. By the autumn of 1939 other deposits were known at Bryson, Calumet Island, and near Wakefield, Quebec.

At the present time Aluminum Company of Canada is mining two deposits near Farm Point, 3 miles south of Wakefield. One of these, the Maxwell quarry, was opened in 1942. Originally the deposit was 900 feet long with a maximum width of 400 feet and depth of 650 feet below the highest point or surface. In October 1960, the deposit had been mined to a depth of 250 feet. The other deposit, known as the "Cross occurrence", is about 500 feet in diameter and has only recently been quarried.

The extraction of brucite nodules from crystalline limestone is unique. This process, developed by Goudge, involves burning of the limestone and removal of the brucite nodules. Crushed ore is calcined in rotary kilns, water is added and the finely-divided hydrated lime is removed by controlled air-currents. Any remaining impurity is removed by shaking tables where separation is based on differences in specific gravity of minerals, and by washing and screening.

Other Mines and Quarries

Feldspar has been taken from a number of pegmatite dykes north of Ottawa. Early quarries (1880-1900) were near Templeton Station, Quinnville and Mine de Mica. Except for a brief period around 1900 feldspar production from this part of Quebec has been continuous. Today, production is almost entirely confined to the properties of Canada Flint and Spar on the east side of the Lièvre River.

Chrysotile asbestos occurs in many places throughout the district. A small deposit on the Dodds Lake Road in Portland West township was tested with an inclined shaft in 1895, and with an adit by Eastern Asbestos Ltd. in 1956. A deposit at Paugan in Low township was worked in 1895 by the International Asbestos Co. of Newark, N.J.; production during that summer was said to average 75 tons of ore a day. Several attempts have been made to mine asbestos near Perkins Mills, perhaps most actively by the Templeton Asbestos Co. in 1892. At that time a shaft was put down 85 feet and the ore was taken to Buckingham for milling. Other occurrences are at Old Chelsea and various places in the Gatineau district.

Narrow barite veins are rather common in Hull and Templeton townships. The Foley mine was worked by the Montreal Paint Company in 1898 and 1899 at a site 1½ miles east of Cantley. Unfortunately much of the barite was intimately mixed with calcite and fluorite. Another vein was mined near Old Chelsea; the pit was subsequently filled and apparently now underlies the Kingsmere road.

PROSPECTS

A few molybdenite prospects are known in the Hull-Eardley district. The most promising is probably the National Molybdenite or Chaput-Payne property. A number of trenches and pits were put down in 1917, the largest being 25 feet in diameter and 15 feet deep. The average grade is low (less than 0.2 per cent MoS_2). Some drilling was done in 1956 by Noracme Mines Ltd.

Gemstones have been taken from a few small pits in the Gatineau region. About 1880, at the McBryde and Mullin properties near Wakefield, pits were excavated and a few straw-yellow garnets and a little cat's-eye wollastonite were recovered. The Leduc mine, 2 miles west of Wakefield Lake, was worked by M. J. O'Brien for gem tourmaline in 1908. Some clear-green material was recovered but the proportion of crystals suitable for faceting was small. The Villeneuve-mine peristerite and the Scott-mine jasper are well-known lapidary materials.

In 1956, Frobisher Ltd. explored certain niobium-uranium occurrences near Meach Lake. These appeared as breccias and dykes associated with the Wakefield syenite. They were too small and scattered to be of economic value.

PART TWO

FIELD TRIP 1:
GATINEAU PARKWAY, HULL-KINGSMERE SECTION

Road Log

Distance (miles)	
0	Baillot and Laurier streets, Hull: proceed to Route 11 and turn north;
2.0	turn left off Route 11 at Gamelin Street;
3.4	turn right onto Gatineau Parkway.
4.25	STOP 1: Biotite gneiss.
5.2	STOP 2: Crystalline limestone.
9.9	KINGSMERE: Crystalline limestone, quartzite, diabase.
11.8	BLACK LAKE: Diopside-oligoclase gneiss.

STOP 1: BIOTITE GNEISS

Take the Gatineau Parkway 0.8 mile north of Gamelin Street. About 100 feet east of the road is a fine outcrop of gneiss. The rock probably represents an impure shale that has been changed by heat and pressure. Although it has been steeply tilted, the original layering has been preserved and indeed

accentuated by alternate zones of light and dark minerals (see Figure 5, page 5). The rock is no longer of simple mineralogy but is now made up of quartz and feldspar (microcline and albite) with lesser amounts of biotite, garnet, epidote (pumpellyite) and a number of other components. The assemblage is one of low-temperature metamorphism.

The gneiss is not of uniform composition but certain layers differ notably from others. There are, for example, bands rich in pea-sized grains of red garnet. Other layers, rich in quartz, are presumably remnants of ancient sandstone strata. The largest quartzite layer is 5 feet wide. The quartzite contains considerable red microcline and jet-black tourmaline, the latter being most abundant near the gneiss. The boron necessary to form tourmaline was possibly derived from shale during metamorphism.

Near the west side of the outcrop are several dykes of diabase which forced their way through the gneiss in molten condition. They are fine-grained and dark green but on exposure to the weather turn a rusty brown. The largest dyke is about 2½ feet wide and trends roughly N80°E, approximately parallel to the main diabase dykes of the Gatineau-Lièvre region. The gneiss has been sheared within 6 inches of the contact by the forceful intrusion of the diabase. Smaller dykes are not consistent in trend; some are cross-cutting, others are chanelled by the layering of the rock to become sills. In detail the dykes are irregular; they pinch and swell, change direction, and branch.

STOP 2: CRYSTALLINE LIMESTONE

Next to gneiss, crystalline limestone or marble is the most common rock type of the Gatineau region. There are good exposures on the Parkway from 1.6 to 2.7 miles north of Gamelin Street. White rock in the roadcuts near the northern part of this section and the isolated blocks in an open field to the south are composed of metamorphosed limestone. Surfaces are precipitous and rugged in detail but individual hills are low. The highest cliff drops 75 feet into a field on the western side of the limestone mass.

An abundant and characteristic mineral is serpentine, which in some places gives the rock a distinctive greenish tinge. Blocks composed mainly of resistant serpentine are perched on a field at the south side of the road 2.0 to 2.1 miles north of Gamelin Street. The more soluble calcite has been dissolved away. Phlogopite mica, altered diopside, and vermiculite are also common. The abundance of the hydrous magnesium silicates, such as serpentine, phlogopite and vermiculite, suggests that the original rock was an impure magnesium limestone, which was later altered with the aid of hot solutions into a silicated marble.

Examine the marble roadcuts to the north. The steeply dipping pink layers may represent strata of slightly different composition in the original sedimentary rock. Note the dark grey, included fragments which together with the light matrix form a breccia. The fragments may belong to a brittle stratum that was broken when the limestone flowed under pressure (see Figure 15, page 24).

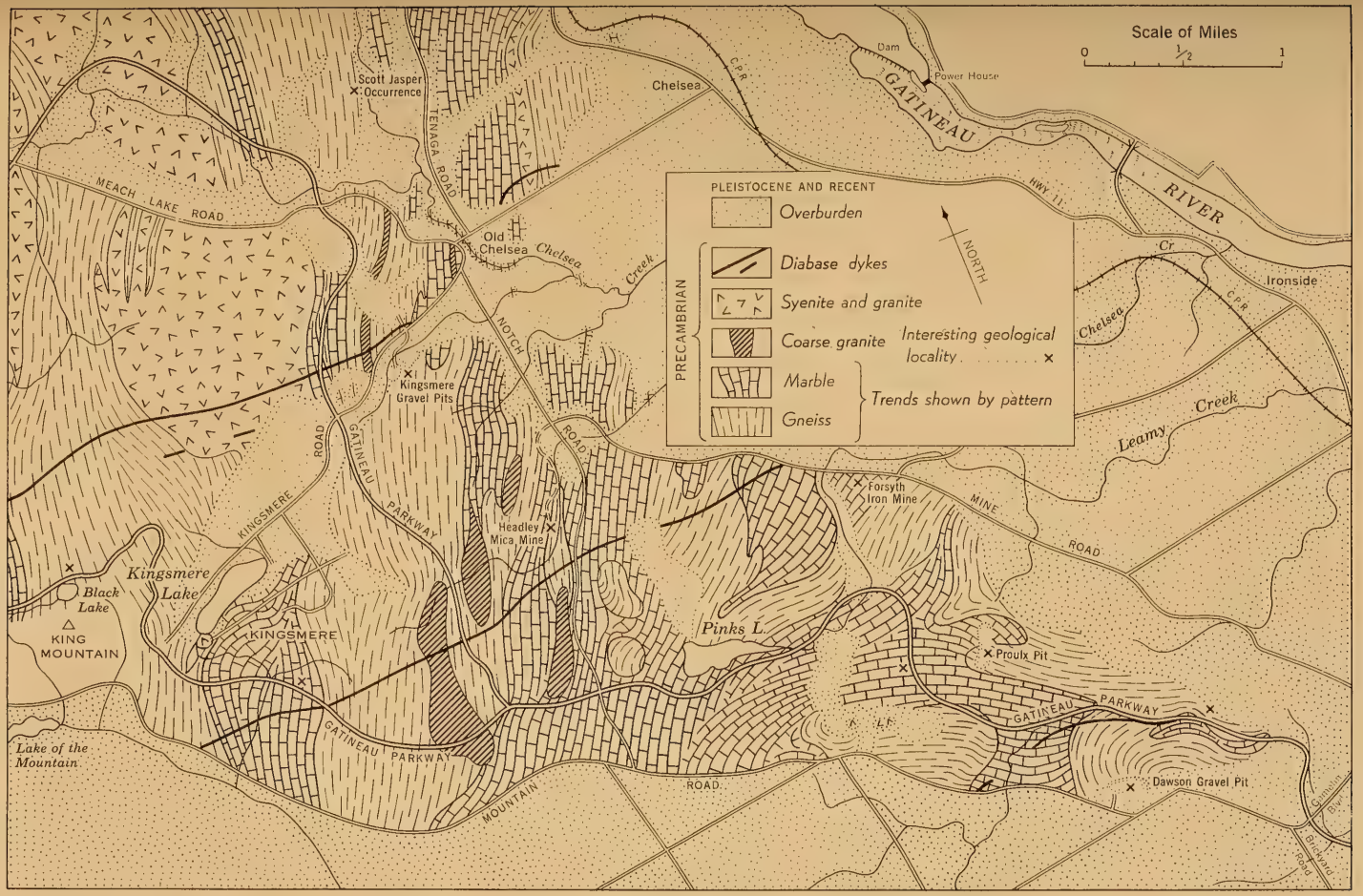


FIGURE 10. Geology of the southern part of the Gatineau Park.

KINGSMERE: CRYSTALLINE LIMESTONE, QUARTZITE, DIABASE

A short walk south from the Kingsmere parking lot below "the Ruins" brings one to a roadcut in green rock. This was probably once an impure limestone but is now mainly composed of quartz, diopside and tremolite with occasional veins and cavities filled with coarse orange calcite. In other places quartz is so abundant that the rock could be termed an impure quartzite.

The quartz-diopside-tremolite-calcite assemblage represents an intermediate stage between limestone and pyroxenite, and in this respect is similar to the rock at the Headley mica mnie (see Field Trip 3, page 23). At Kingsmere, phlogopite mica occurs irregularly in bunches. Elongated crystals of black tourmaline and formless orange garnet are common in each deposit. Many pyroxenites of the Gatineau region grade from limestone on one side into quartzite on the other.

This rock contains considerable calcite that is easily attacked by water and it is therefore not surprising that portions are cavernous. A natural well at the upper end of the roadcut flows when the water-table is sufficently high (normally until mid-July).

The flanks of this outcrop are covered by a silty clay, full of stones and boulders. This is a till comprising material carried and laid down by the glaciers of the Ice Age.

About 100 yards south is an outcrop of silicated limestone or impure quartzite containing considerable feldspar. This is cut by a diabase dyke about 75 feet wide – the middle dyke of the three principal diabase dykes of the region. Each trends approximately east-west. They are not continuous but pinch and reappear along their strike. The two northern dykes can each be traced about 4 miles but are rarely more than 150 feet wide. The southern dyke is wider but shorter.

Diabase is a rock that can be recognized by its rusty and rounded surfaces. It is much harder than most rocks of the region and emits a characteristic ring when struck with the hammer. Under the microscope it is seen to be composed almost exclusively of long crystals of labradorite feldspar, stubby brown grains of pyroxene and rounded crystals of magnetite.

This rock was intruded as a liquid and was rapidly cooled along its borders. Such 'chilled contacts' are manifest by a zone of extremely fine grain. Within 3 feet of the contact individual grains cannot be identified with the unaided eye, whereas in the centre of the dyke grains are up to $\frac{1}{4}$ inch across.

BLACK LAKE: DIOPSIDE-OLIGOCLASE GNEISS

A dark-green rock underlies much of the Parkway and Camp Fortune. This rock was probably a shale that has been altered by heat and pressure. Although new minerals have been formed the bulk composition has remained about the same.

The new rock is made up of approximately equal amounts of dark minerals (diopside, subordinate mica and actinolite) and feldspar (oligoclase and microcline). Compared with the paragneiss at the southern tip of the

Parkway, this rock has been metamorphosed at a higher temperature – diopside and oligoclase replacing biotite, actinolite and albite. In addition, the initial shale was not interbedded with sandstone.

A fresh exposure of this rock is seen opposite Black Lake. The gneiss is crisscrossed by numerous pegmatite dykes and interlayered with a few small pegmatite sills. The pegmatite is mineralogically simple, being composed almost exclusively of quartz and pink microcline. These minerals are not arranged in zones.

Stratification in the gneiss is hardly evident in fresh exposures but is accentuated on weathering. A weathered surface is seen on the west side of the lake. Stratification is due to bands of minerals alternately rich in pyroxene and oligoclase. It is enhanced by oriented mica flakes.

FIELD TRIP 2:
GATINEAU PARKWAY, FORTUNE-McCLOSKEY SECTION

Road Log

Distance (miles)	
0	Baillot and Laurier streets, Hull: proceed north on Route 11;
8.9	turn left at Chelsea;
11.4	turn right onto Meach Lake Road at Old Chelsea;
12.9	turn left onto the Gatineau Parkway.
14.1	FORTUNE LAKE: Syenite, pegmatite, breccia and schist.
15.6	CHAMPLAIN LOOKOUT: Pyroxenite, pegmatite, breccia and schist.
16.7	MCCLOSKEY'S FIELD: Aplite, pegmatite and dolomite.

FORTUNE LAKE: SYENITE, PEGMATITE, BRECCIA AND SCHIST

The Parkway cuts through syenite near Fortune Lake (Figure 11). This syenite is a mottled greenish rock, composed of pink microcline, grey plagioclase, black hornblende and a number of minor constituents. The location is near the southern extremity of the large Wakefield syenite mass.

At Fortune Lake opposite the parking lot the syenite is especially rich in black mica and brassy pyrite. It appears to have been emplaced as a molten rock at great depth but shows evidence of subsequent change (metamorphism). Cavities are filled with orange-pink calcite that was introduced at high temperature and reacted with syenite to produce envelopes of green amphibole and pyroxene surrounded by black biotite. Fracture planes are commonly coated with blue-green amphibole asbestos, less commonly by yellowish green epidote. Fragments of a dark rock appear to have been caught up in the molten mass.

A few pink dykes cut the syenite. Sugary-textured aplite, composed of microcline and quartz, grades into coarse-grained pegmatite of the same composition. Aplite and pegmatite are very abundant in the Wakefield syenite and in places are the most common rocks. They were introduced in the molten state after the syenite had solidified.

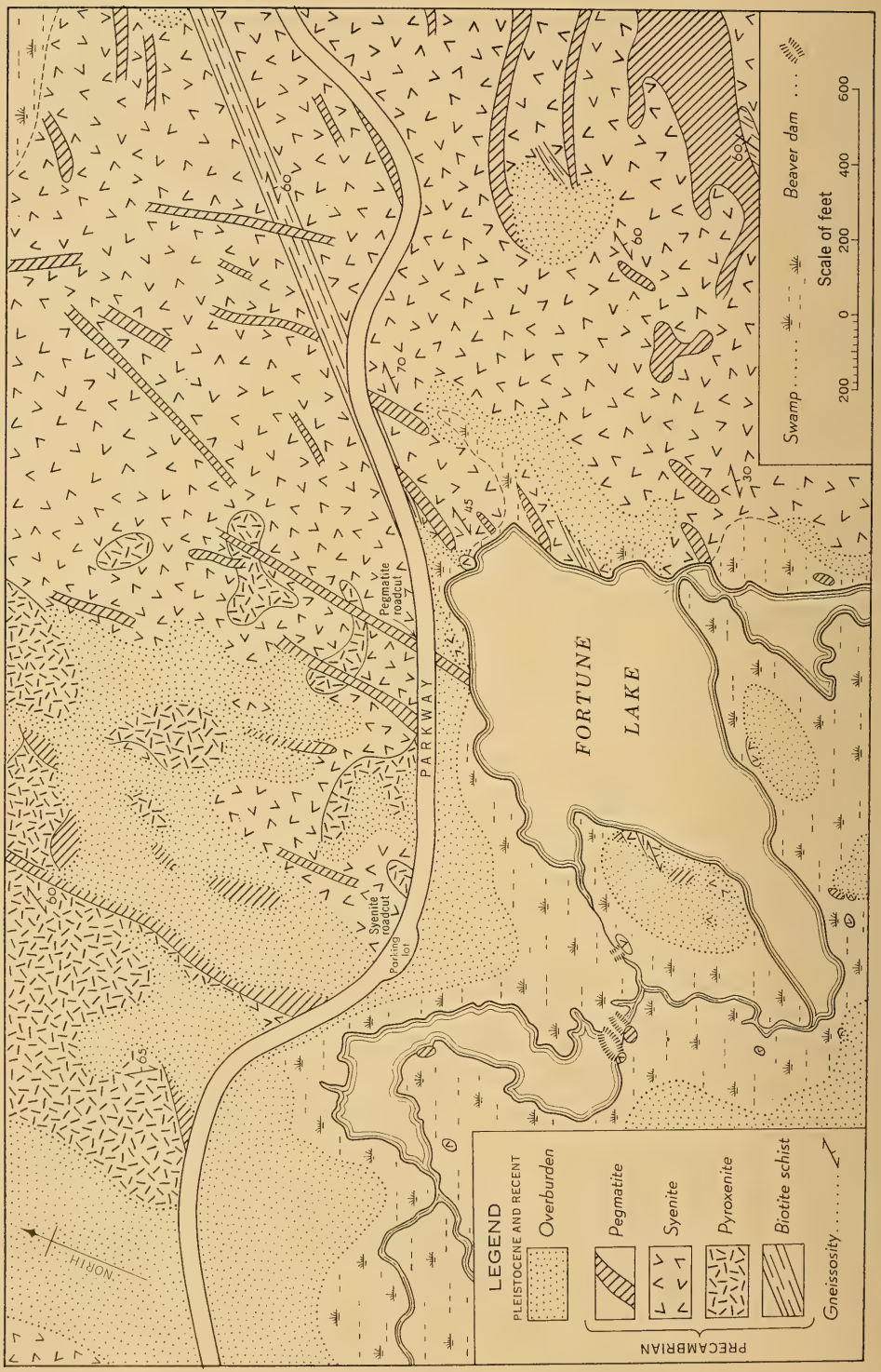


FIGURE 11. Geology of the Fortune Lake area.

About 200 yards east of the last occurrence, the Parkway cuts through a large pegmatite dyke. The pegmatite is composed of quartz, microcline and plagioclase. As at Black Lake these minerals are not arranged in any specific zones. In certain places a graphic intergrowth of quartz and feldspar can be observed. The molten pegmatite reacted with the wall-rocks, particularly on the east side, producing the dark garnet andradite (see Figure 1, page 3). This garnet is unusual because it contains about 2 per cent yttrium.

Still farther east is a breccia containing fragments of syenite cemented by biotite, iron oxide and microscopic apatite. The occurrence is radioactive due to small amounts of the rare mineral betafite. On the east the breccia is bounded by a dark micaceous rock or schist.

CHAMPLAIN LOOKOUT: PYROXENITE, GNEISS AND MOLYBDENITE

At this locality the Parkway cuts through metamorphic pyroxenite, a rock composed of dark green pyroxene or sahlite and lesser amounts of calcite, actinolite, feldspar, sphene, mica and quartz. Solution cavities in calcite locally contain loose books of mica and shiny pyroxene crystals coated with tiny prisms of apatite (see Figure 3, page 4). Well-formed feldspar and quartz crystals are occasionally found. A roadcut just before the Lookout exposes a lens of sugary, green apatite.

Below the Lookout is the Chaput-Payne property that was tested for molybdenite during World War I. It contains numerous small excavations, the largest being a test pit 25 feet across and 15 feet deep. The main lead can be traced for at least 250 feet. Its upper part is rich in mica – the vein having the appearance of the mica-calcite-pyroxene lodes of the Gatineau Valley – but below, it contains a pink calcite core rich in molybdenite. Some of the molybdenite flakes are an inch across. The surrounding pyroxenite also contains coarse-grained molybdenite. Other minerals are actinolite, phlogopite, sphene, uraninite, scapolite, pyrite, pyrrhotite and sphalerite.

The pyroxenite grades imperceptibly into a rusty-weathering gneiss, generally rich in pyroxene and sulphides but occasionally with dominant mica and feldspar. The gneiss and associated pyroxenite and limestone have been drawn out into long streamers, like tentacles of an octopus (Figure 12). The gneiss contains finer-grained molybdenite than the pyroxenite and the molybdenite seems to be confined to fracture surfaces. It was possibly derived from solutions genetically connected with pegmatite dykes that intrude the gneiss. This locality is on the eastern side of a large molybdenite-rich area centred around Quyon.

At the foot of the escarpment is the Ottawa Valley plain. The rocks beneath the earthy covering are Ordovician limestones preserved in a trough that sank many feet along faults bounding the plain.

MCCLOSKEY'S FIELD: APLITE, PEGMATITE AND DOLOMITE

McCloskey's field (Figure 13) is in the southwest part of an area of aplite, 1½ miles long and 1 mile wide. Aplite is a pink sugary-textured rock composed of microcline and varying amounts of quartz and plagioclase. Dark

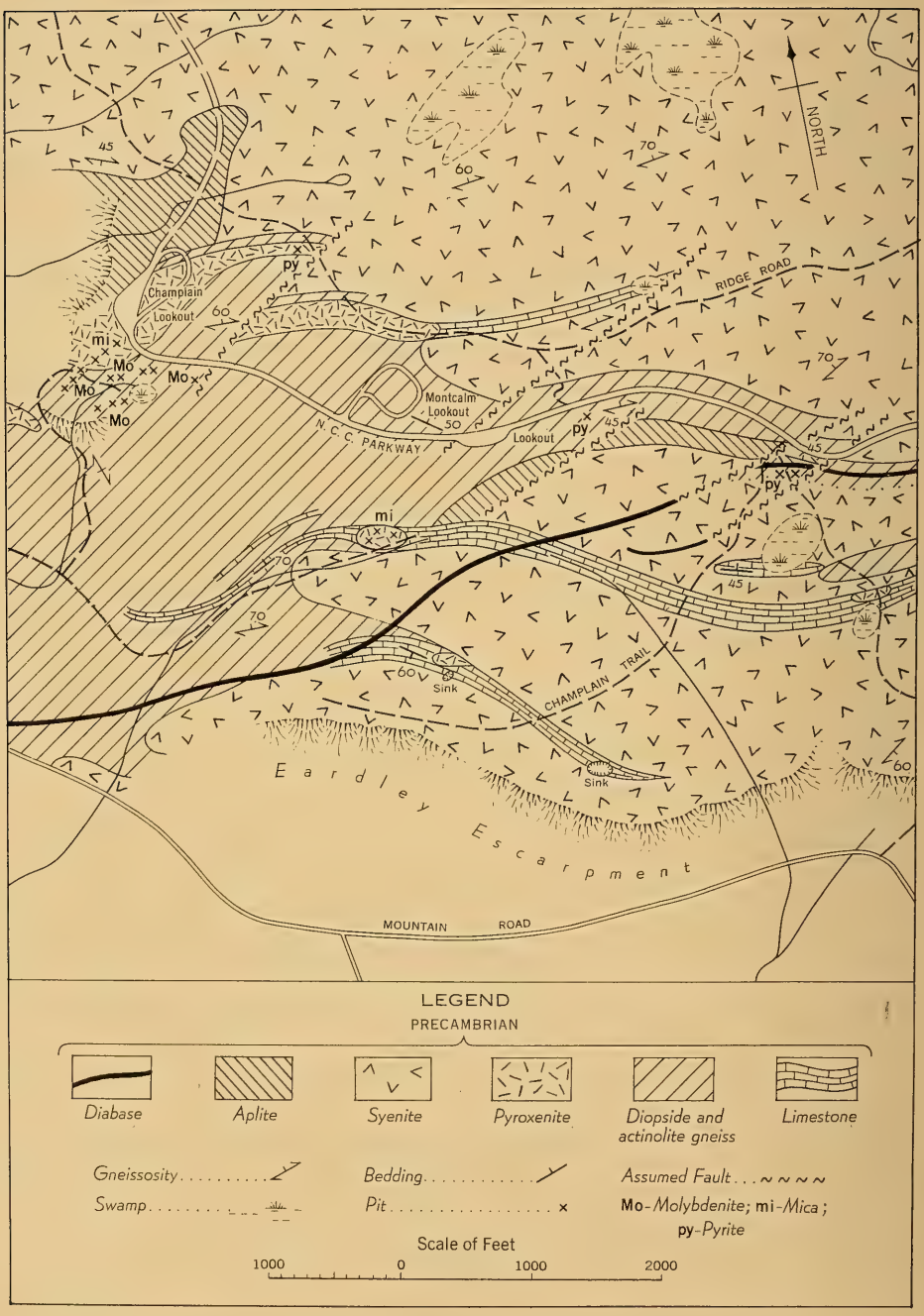


FIGURE 12. Geology of the region near the Champlain lookout.

FIGURE 13. Geological map of McCloskey's field.

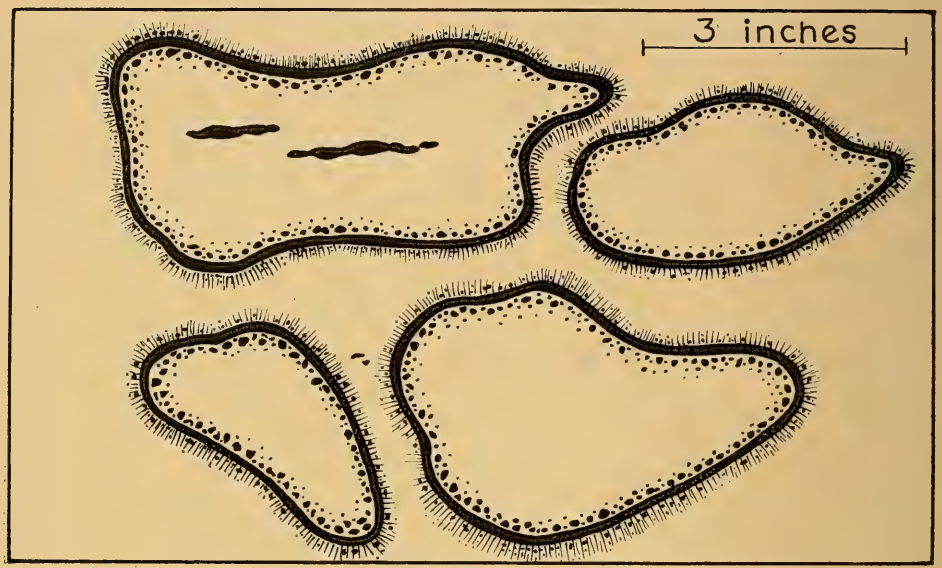


FIGURE 14. Orbicular arrangement of amphibole in aplite (McCloskey's field).

minerals are mainly confined to radiating tufts, circular structures and veins of a bluish green amphibole, and are in places accompanied by a little brown mica. Good examples of amphibole (Figure 14) may be seen below the large pegmatite dyke. The mineral is an unusual and beautiful one. It is actinolite with a high percentage of sodium; the varieties highest in sodium are dark greenish blue. It is commonly very coarse – in a vein east of the field, individuals a foot long were observed. The crystals are elongated and tend to break in planes or cleave along their length. Some crystals also display a marked cleavage across their length. This so-called basal parting is a feature distinctive of pyroxenes and is almost never found in amphiboles.

The pegmatite itself is worth examination. It is composed mainly of coarse-grained feldspar and quartz. By rotating a specimen of feldspar in sunlight, reflections may be given from both the principal pink mineral (microcline) and thin braids of a whitish mineral (plagioclase). This is the intergrowth perthite (so called because the original specimens came from near Perth, Ontario). In other fragments the foreign matter is translucent grey quartz and shows no mirror reflection. Quartz may be present in angular grains, and to this rock the name graphic granite is sometimes applied. The failure of two small feldspar pits is attributed mainly to the large amount of quartz intergrown with the feldspar. Other interesting minerals are very dark pyroxenes (especially in the eastern pit) and rare crystals of sphene and uranothorite.

Within the aplite are isolated occurrences of carbonate rocks. These are very different from the limestones of Pinks Lake and Kingsmere because (1)

they hold a great deal of dolomite and are best classified as dolomites and dolomitic limestones; (2) they are discontinuous; and (3) they contain considerable quantities of distinctive accessory minerals.

The mineral dolomite is a calcium-magnesium carbonate in contrast to calcite, the calcium carbonate. Calcite is much more soluble than dolomite. On weathered surfaces coarse-grained calcite has dissolved away leaving salient medium-grained dolomite. In addition the dolomite contains a little iron and weathers to a brown colour. An idea of the dolomite content can therefore be obtained from the colour of the outcrop. An occurrence of calcitic limestone may be seen on the Ridge Road just south of the field.

Detailed examination has shown that the dolomites and dolomitic limestones are very late in the geological sequence. They appear to have been squeezed into fractures in a hot plastic state. Tongues in some places cut the aplite and in certain instances blocks of aplite and syenite have been engulfed in the limestone. The borders of the limestone are commonly lined with several inches of biotite and in places considerable actinolite. These minerals may have been formed by reaction of hot limestones with the aplite.

The mineral composition of the carbonate rocks is also striking. There are alternating bands of dolomite and calcite but within the dolomite are bands rich in fine-grained apatite. Pyrite is universally present. Actinolite is found in both calcite and dolomite. Occasionally we see magnetite crystals. The rare mineral betafite occurs along fracture planes.

FIELD TRIP 3: MINE ROAD – TENAGA ROAD

Road Log

Distance (miles)	
0	Baillot and Laurier streets, Hull:
2.0	turn left from Route 11 onto Gamelin Street;
2.8	turn right onto Mine Road (Maurice Street).
5.8	FORSYTH IRON MINE.
7.6	HEADLEY MINE: Apatite and mica.
8.4	Kingsmere Road, turn right;
8.7	Tenaga Road, turn left;
9.4	Crawley Films Ltd. and the SCOTT JASPER OCCURRENCE. return to Kingsmere Road;
10.1	Kingsmere Road, turn right;
10.7	road to gravel pit on left;
11.2	KINGSMERE SAND PITS.

FORSYTH IRON MINE

Magnetite at the Forsyth mine occurs in a lens that is parallel to the stratification of the enclosing crystalline limestone. The lens dips almost vertically. Magnetite occurs in massive form and also as small disseminated grains. The boundaries of the lens are, however, rather sharp. Hematite

FIGURE 15. Breccia showing contorted dark inclusions of amphibolite in crystalline limestone (Forsyth mine).

and jasper are commonly encountered near the margins of the deposit but are rare in the central part.

The magnetite body occurs in the eastern flank of a syncline, a trough-shaped fold. When the structure was formed, successive beds slipped one over the other. During this process brittle layers of dark metamorphic rocks were broken and engulfed in the more plastic marble. The resulting breccia has been encountered as discontinuous lenses in underground workings (Figure 15). Some fine examples of breccia can be seen as blocks in the waste dump near the Mine Road.

At this deposit the following minerals occur as collector's items:

Chlorite – Large flakes of green and purple chlorite have been found in the old pit.

Fluorite – Green fluorite is occasionally found in calcite veinlets.

Graphite – This is common in limestone, but generally in small flakes.

Magnetite – Some of the magnetite is intrinsically magnetic; when broken, small chips tend to stand up on end on the parent fragment.

Scapolite – Large crystals of green scapolite have been observed in pyroxenite blocks on the dump.

Cordierite – Deep blue cordierite is a rare constituent of the schist south of the Forsyth mine.

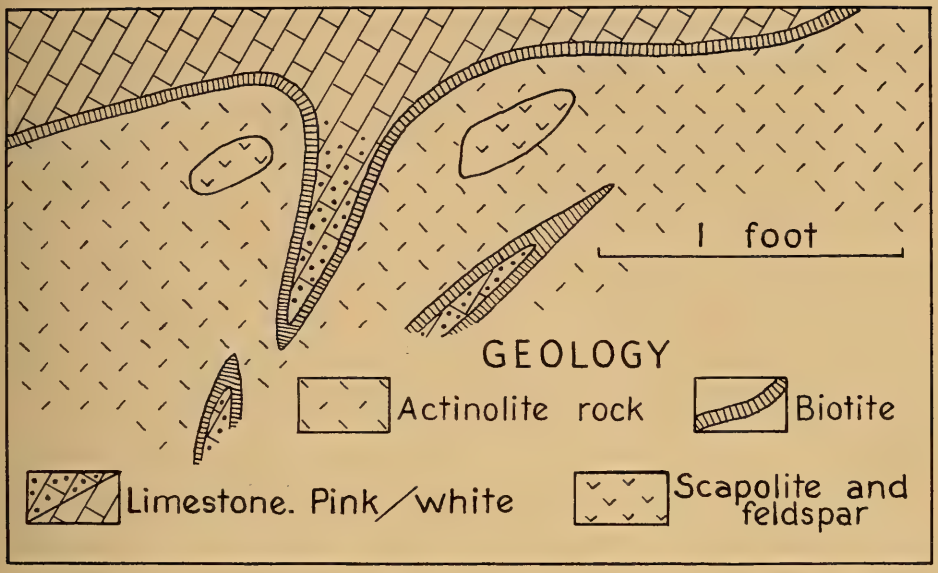


FIGURE 16. White crystalline limestone grading into pink calcite (Headley mine).

HEADLEY MINE: APATITE AND MICA

Take the Mine Road to the junction of the Notch Road and walk west along a well-worn trail. Proceed ⅓ mile (past the second field) to a fork in the trail. Take the right-hand fork and proceed another 400 yards to the main pit.

The Headley mine comprises a number of pits, the largest being 40 feet long, 15 feet wide and 20 feet deep. The mine was worked many years ago for phosphate and later for mica. The property is now owned by Walter C. Cross and Co.; it was worked in 1960 by Leo Joanisse of Hull.

The best exposure is in the main pit where mica veins occur in crystalline limestone and occasionally in a diopside-actinolite rock: Pyroxenite on the west appears to grade transitionally into crystalline limestone on the east. Some pockets of pink calcite containing isolated books of coarse silver-amber mica occur directly in apatite-rich limestone, while others with a more vein-like appearance are bounded by a zone of phlogopite. To the latter category belong veins where the colour of calcite grades from white in the limestone to pink in tongues within actinolite rock (Figure 16). In this case, limestone appears to have been squeezed into fractures and its colour changes to pink.

Large and well-formed books of mica have been (and can still be) found on the dumps. The mica is light silver-amber and a large proportion is of premium grade. The six-sided plates may show light and dark zones, indicating that the composition of the parent solution suddenly changed as the crystal grew (see Figure 17).

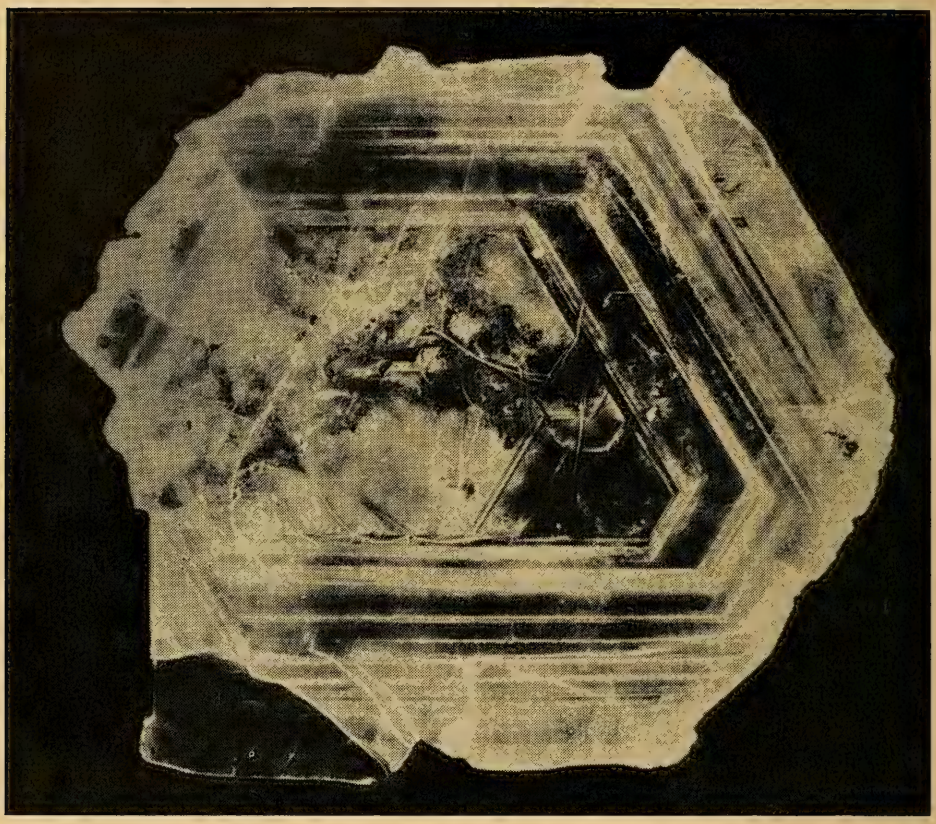


FIGURE 17. Zoned phlogopite crystal (Quebec mica region).

A notable feature is the distinct double asterism. Take a thin splitting of mica and, holding it close to the eye, look at a point source of light (such as a bare electric bulb across the room). You will see a strong six-rayed star super-imposed on a weaker six-rayed star. This is the phenomenon of double asterism presumably caused by the channelling of light by oriented impurities within the mica. All Ottawa Valley phlogopite displays this property but none better than the silver-amber mica of the Headley mine.

The pit is remarkable for furnishing a large number of minerals from such a restricted area. Calcite, phlogopite, apatite, diopside and actinolite have already been mentioned, but the writer has also found garnet, tourmaline, scapolite, wilsonite, pyrite, pyrrhotite, sphalerite, albite, vesuvianite, quartz and sphene in place in the main pit.

SCOTT JASPER OCCURRENCE

The jasper occurrence is off the Tenaga Road 0.7 mile north of Old Chelsea. The Scott pits are just inside the woods and about 550 yards north-west of Crawley Films. This mine has not been worked during this century.

FIGURE 18. Plan of the Scott mine.

It was originally opened as a phosphate property but the apatite was mixed with too much hematite to be of value. Later it was mined for mica, and 10 or 12 tons of phlogopite was taken from the main pit.

Of interest to the lapidary is the abundance of jasper encountered in the mine excavations (Figure 18). Occurrence No. 1 is a pit 20 feet long, 10 feet wide and 5 feet deep. Pieces of jasper are common in the dump and small veins may be seen cutting chloritic gneiss in the pit. The jasper has a fragmented or brecciated aspect. It may contain fragments of gneiss and quartzite and is itself broken by veinlets of red hematite and specularite. The jasper contains small opening or vugs lined with quartz crystals. It is generally red-brown but commonly is orange or even yellow; on the dump, some pieces have weathered pink.

Occurrence No. 2 is the remains of a small stockpile of apatite. A little jasper is associated with apatite and pink calcite. The exact source of this material is not known.

No. 3 is the main pit, 40 feet long, 10 feet wide and as much as 10 feet deep. Jasper is visible at the contact of crystalline limestone and gneiss. The jasper widens downward and is 2½ feet wide at its base. Its colour is brick-red, though it contains spheres of yellow material up to an inch across. Jasper is commonly cut by quartz-hematite and calcite-barite veinlets. Cavities are either filled with calcite or quartz.

No. 4 and No. 5 occurrences are small and badly weathered pits. The waste pile of pit No. 4 shows some pink calcite with apatite and mica. The mica is in places cemented with red hematite. Mica splittings cover the ground at locality No. 6.

The occurrence farthest south, No. 7, exposes abundant but poor-quality jasper. The vein is 2½ feet wide. It dips into a 10-foot ledge of pegmatite at about 30 degrees. Red jasper is flecked with calcite and barite grains, contains some calcite bands, and is riddled with vuggy and glassy quartz. Both jasper and the underlying pegmatite are sprinkled with a little specularite.

Jasper is not restricted to the pits of the Scott mine. It is found in wells to the east and in veinlets cutting gneiss between occurrence No. 6 and No. 7. Jasper boulders occur in the drift near Old Chelsea.

The origin of the jasper is uncertain. Except for the Scott mine, jasper is almost unknown in the Gatineau region. G. J. R. Hannah notes (M. Sc. thesis, Laval University, 1952) that microscopic textures and structures suggest the mineral was deposited from dilute watery solutions at low temperatures (less than 200°C).

Good-quality red jasper can still be obtained from locality No. 3 and fair-quality yellow from No. 2. However, owing to many veins and inclusions of soft material, large pieces are rarely found.

KINGSMERE SAND PITS

The Kingsmere sand pits are owned by William Ryan of Old Chelsea and are at present worked by the National Capital Commission. They are approached by a road leading south off the Kingsmere Road into a field, 0.6 mile west of Old Chelsea. Half a mile along, this road leads to the upper pit – a shallow excavation about 300 yards long and 100 yards wide. A road from the southeast corner of the pit connects to a smaller pit below.

A sump-hole at the base of the lower pit has penetrated silts containing abundant marine fossils of species living to-day. The small size of the shells indicates a cool climate.

The upper pit exposes sand that was apparently deposited in a river delta shortly after the retreat of the sea. The inclined stratification may be truncated, resulting in crossbedding (Figure 19). This is due to a sudden change in the direction of current. In some places hollows have been filled with sand resulting in a scour-and-fill structure. In others, irregular series of folds may be seen. These were probably caused by slumping of the wet sand.

A stratified boulder bed near the base of the upper pit has been only partly preserved. The boulders are angular but the bed lies on a rounded rock surface has been smoothed by glaciers. A second boulder bed lies near the top of the pit and, in contrast to the lower bed, the boulders are unsorted and well-rounded. In places they are partly decomposed; at the lower pit, some of the boulders from this bed can be dug into with the bare hand.

The origin of the decayed boulders is uncertain. They probably predate the glaciers but certainly could not have been transported far in their non-coherent state. Perhaps they were situated on a slope that was preserved from glaciation and rolled down on the delta some time after the Champlain Sea disappeared.

Some 2 feet of sand overlies the upper boulder bed. It appears to be recent and windblown.

FIGURE 19. Crossbedding of a type commonly seen in the Gatineau-Lièvre region.

FIELD TRIP 4: WRIGHTVILLE – MOUNTAIN ROAD

Road Log

Distance (miles)	
0	Baillot and Laurier streets, Hull:
1.4	CANADA CEMENT COMPANY QUARRY: Ordovician limestone.
1.7	turn right onto Route 11;
2.0	turn left onto Gamelin Street;
3.6	turn right onto Mountain Road.
4.6	DAWSON GRAVEL PIT.

CANADA CEMENT COMPANY QUARRY: ORDOVICIAN LIMESTONE

This quarry is north of Montclair Avenue East in Wrightville. The company's permission is required before the property may be visited. The local limestone is mixed with a slurry of marine clay pumped from near Ironside and a small amount of sandstone brought from Bell's Corners, Ontario. This material is crushed, ground, calcined and bagged as cement at the plant.

Limestone has been taken from this site since the turn of the century. The quarry is about 520 yards long, 240 yards wide and 40 yards deep (October 1960). Mining operations have taken place from two horizons or benches. The rock is blasted from holes put down by 6-inch churn drills.

The limestone is rather uniform in composition, grading from 45 to 55 per cent lime. The only visible impurities are a few shale partings which, in some places, contain nodules of chert. An alternating grey and black banding

is due to variation in organic content; thus some rocks give a fetid odour when struck with a hammer. The light-coloured limestone is notably coarse-grained. Sandstone on the quarry floor has been derived from outside.

Use is made of natural fractures or joint systems and the bedding planes in quarrying the rock. The bedding planes are by far the best-developed and are almost horizontal. In some cases the joints are coated white with small calcite crystals.

Fossils are most prolific in a horizon near the top of the quarry but may be observed in the broken rock on the quarry floor. The sediments laid down in the Ordovician Sea have been correlated with the Black River – Trenton strata of New York State by the index fossils they contain. Noteworthy are the scarab-like tribolites (*Isotelus*), lampshells (*Rafinesquina*), and cup-like bryozoans (*Prasopora*).

Dawson Gravel Pit

The Dawson pit is on the Mountain Road 1.1 miles northwest of the junction of Gamelin Street and the Brickyard Road. It is owned and operated by the National Capital Commission. In November 1960 the pit was being worked near the southeast corner, and excavation had disclosed a number of interesting features.

The section shows 5 feet of silty clay which overlies 1 foot of silt; this in turn overlies pebbly sand, now largely obscured by talus. None of these layers contains fossils. Their composition suggests they were laid down in fresh water. The clay does not contain calcite which is common in the marine clay of the Ottawa region. It is well stratified and includes oxidized layers. Silt and clay were probably deposited in shallow quiet water. In contrast, the pebbly sand may represent outwash from the glaciers.

At another face may be seen sand layers interbedded with grey silt. In each sand layer the texture grades from coarse at the bottom to fine at the top. This 'graded bedding' has resulted from deposition in quiet water, the coarse particles settling faster than the fine. Alternation with silky layers may be due to seasonal variation.

At still another face in the pit, crossbedding is apparent. The structure is on a much smaller scale than the crossbedding of the Kingsmere sand pit. It may result from sand having been sculptured by shallow running water to produce lamination of one set of ripples oblique to the next. The occurrence of graded bedding close to crossbedding is unusual.

On a fourth face, layers have slipped along steeply inclined planes producing fault surfaces. This can be explained by slipping of the sediments in a frozen or partly frozen state.

Another gravel pit is just east of the Gatineau Parkway, 2.0 miles north of Gamelin Street. This also may represent a glacial outwash deposit. Part of the gravel is made up of coarse crystalline limestone, a rather unusual component indicating very rapid deposition and burial. Certain gravel layers are rich in marine shells, but these are mostly broken and not in an upright position, suggesting that they were transported from another site.

FIELD TRIP 5: CANTLEY ROAD

Road Log

Distance (miles)	
0	Baillot and Laurier streets, Hull: proceed north on Route 11;
5.1	turn right onto Limbour Bridge;
5.6	Cantley Road, turn left.
9.6	Road leading on left to NELLIE AND BLANCHE MICA MINE.
14.5	Road leading on left to DACEY MICA MINE.
17.5	Road leading on left to LAFLÈCHE CAVERNS.
20.7	Road leading on left to the ST. PIERRE DE WAKEFIELD FELDSPAR QUARRY.

NELLIE AND BLANCHE MICA MINE

The Nellie and Blanche mine can be reached by turning left from the Cantley Road at a point 4.0 miles above the Limbour Bridge; the turnoff is marked by a sign "Kunnamor Cottages". Follow this road for 0.6 miles to a clearing. The mine workings are in the field beyond the gravel pit on the left.

This mine was worked by the Lac Girard System prior to 1900, and the pits are now either flooded or partly grown over. The mine dumps however furnish much information on the mineralogy of a typical occurrence of mica and apatite. The largest dump is more than 100 feet long and 20 feet wide.

At this occurrence, pyroxenite, a coarse-grained dark green rock, is cut by pegmatite containing hard pink feldspar and dark green amphibole. Pyroxenite is the mica-and-apatite carrier and is interbedded with metamorphic gneisses.

Green-coloured minerals are predominant in the pyroxenite, and include:

Diopside – dark green and dull,

Actinolite – somewhat darker and shiny,

Scapolite – light yellow-green cleavage pieces, which weather to woody white or pale mauve,

Apatite – translucent grass-green (somewhat rare).

Scapolite, a characteristic mineral in these rocks, is unusually abundant here. Salmon calcite is shredded through the pyroxenite. Where scapolite occurs with calcite it is white and is commonly found with black tourmaline.

The origin of the Quebec pyroxenites has been subject of much debate. Some people believe that molten pyroxenite invaded the gneiss; others think that pyroxenite represents an alteration of impure limestone brought about by heat from the intruding granites. The proponents of the former, or igneous, theory maintain that pyroxenite is commonly not bordered by crystalline limestone; it may transgress the strike of the enclosing rocks; and commonly contains inclusions of pegmatite. The proponents of the latter, or metamorphic, theory draw attention to the fact that the pyroxenites are generally interbedded with metamorphic rocks that were originally sediments; that they

commonly contain considerable calcite; and that some of their principal constituents such as diopside, phlogopite, scapolite, sphene and actinolite are lime or magnesium silicates that are generally regarded as metamorphic.

DACEY MICA MINE

The Dacey mica mine is operated by Suncrest Mines. Permission for access should be obtained from Mr. G. A. Wheeler, 68 Kenora Street, Ottawa. To reach the mine, drive north on the Cantley Road to a point 8.9 miles above the Limbour Bridge. Turn left to John Holmes' farm and continue past the farm to the mine.

This is a very old mine – originally worked about 1890 for apatite, later (1900-1904) for mica, then 1958-1959) for apatite and calcite as stucco material, and finally (1960) again for mica. The Dacey and Blackburn Brothers mines are the only operating mines in the Cantley – Wilson's Corners district.

The principal workings are exposed over a length of 450 feet on the side of a hill. Apatite and phlogopite occur in a large body of coarse calcite surrounded by pyroxene-rich rocks. The uppermost or western cut exposes large cross-sections of green apatite crystals in pink calcite. About 100 feet to the east is another cut containing apatite and calcite. Considerable 'sugar apatite' may be seen here. Pink calcite is veined by white calcite. The borders of the veinlets have been stained chocolate-brown by iron-rich solutions that permeated from the openings.

Beyond this is the main pit, about 60 feet long and 20 feet wide. The pit is water-filled and, in part, covered with mined debris. It is said to have been 50 feet deep. Coarse-grained mica is exposed on the lower or footwall side of the vein. The mica lead averaged 4 feet in width. Mica crystals do not appear to have much orientation but are positioned at random. Some fine-quality splitting mica was recovered here. Still farther east and near the lowermost part of the exposed area is another deep pit, recently excavated but now flooded.

On the dumps, good-quality mica may be found in a friable banded rock composed of calcite, sugar apatite and phlogopite. Somewhat rarer are six-sided crystals of green apatite, light green crystals of pyroxene, dark green crystals of amphibole and white translucent scapolite. Jet-black tourmaline appears in several places on the dump.

The mica occurrences are 'pocket and fissure' deposits. They are lined with intergrowing mica crystals and filled mainly with calcite containing isolated crystals of mica and apatite. Calcite-rich mica and apatite deposits are rather common in the Gatineau district but much rarer near the Lièvre River. Attempting to determine the origin of the calcite poses an interesting quandary: it could have been derived from Precambrian limestone mobilized through heat and pressure, or it could have been truly igneous or carbonatite. An old impasse to the igneous theory – the difficulty in melting calcite without its decomposition – has now been removed. Laboratory experiments have shown that water-rich carbonate rocks may still be liquid at 700°C and 1000 atmospheres, not improbable conditions for molten rocks within the earth's crust.

FIGURE 20. Stalactites (Laflèche Caverns).

LAFLÈCHE CAVERNS

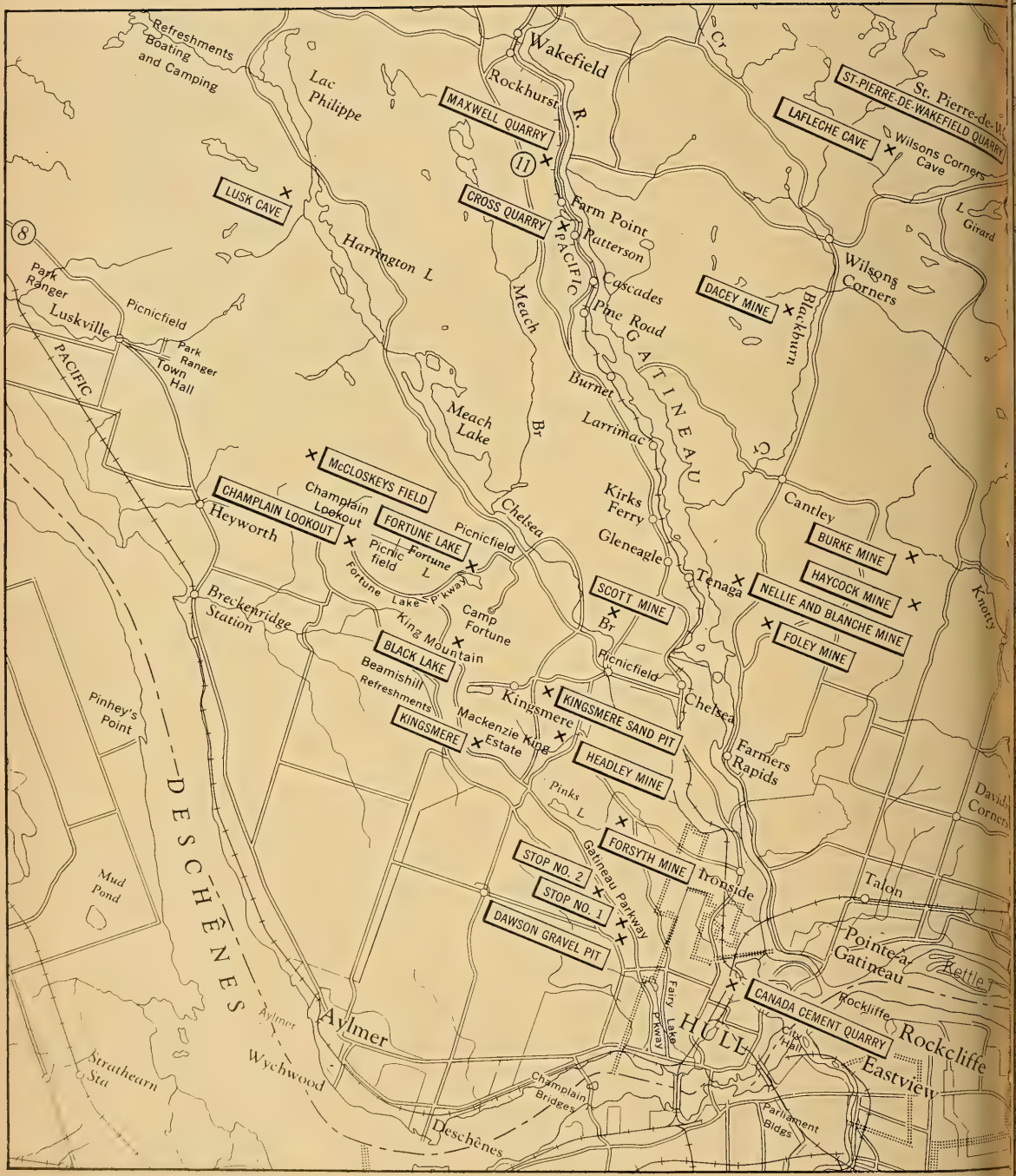
Laflèche Caverns are situated in a narrow band of Precambrian limestone. The main passageway comprises a series of connected openings along a length of 500 feet; the largest room is about 100 feet long, 30 feet wide, and in one place 20 feet high. Another room is 90 feet high and displays notable stalactites and stalagmites (Figure 20). A third room projects 30 feet upwards as a series of chimneys, and at its ceiling, tree roots have penetrated from the surface. Water has filled the lowest parts of the cave; an underwater chamber, 25 feet long, is known to connect with a lake to the east. The cavern remains at a constant temperature of 45°F throughout the year.

The passageways were thought to have been formed in Pleistocene time or earlier. When it was discovered, much of the cavern was filled with stratified sand and gravel containing fossils typical of the Champlain Sea. Deposition of this material must have occurred when the circulation of underground water was much greater than it is today, possibly at the close of the Pleistocene epoch.

Laflèche Caverns were discovered by a hunter in 1865 and were described in detail by Dr. Grant of the Ottawa Natural History Society in 1869. The The caverns were opened to the public in 1923. The present owner has preserved the natural entrances and has opened a new exit with a tunnel 176 feet long. Guided tours are conducted during the summer.

ST. PIERRE DE WAKEFIELD FELDSPAR QUARRY

Take the Cantley Road to a point just beyond a culvert 15.1 miles north of the Limbour Bridge. A $\frac{1}{4}$-mile hike along a road which leads off the highway to the left takes one to the quarry.


Refreshments Boating and Camping
Lac Philippe
Wakefield
Rockhurst
R.
MAXWELL QUARRY
ST-PIERRE-DE-WAKEFIELD QUARRY
LAFLECHE CAVE
Wilsons Corners Cave
St. Pierre-de-W
LUSK CAVE
CROSS QUARRY
Farm Point
Ratterson
PACIFIC
Cascades
Pine Road
GATINEAU
DACEY MINE
Wilsons Corners
Harrington L
Meach
Burnet
Larrimac
Meach Lake
Br
Park Ranger
Luskville
Picnicfield
Park Ranger
Town Hall
PACIFIC
McCLOSKEYS FIELD
CHAMPLAIN LOOKOUT
Champlain Lookout
Heyworth
FORTUNE LAKE
Picnic Field
Fortune L
Fortune Lake Parkway
Chelsea
Picnicfield
Kirks Ferry
Gleneagle
Cantley
BURKE MINE
HAYCOCK MINE
NELLIE AND BLANCHE MINE
FOLEY MINE
Tenaga
SCOTT MINE
Br
Picnicfield
Breckenridge Station
Camp Fortune
King Mountain
BLACK LAKE
Beamishill
Refreshments
KINGSMERE
Mackenzie King Estate
Kingsmere
KINGSMERE SAND PIT
HEADLEY MINE
Chelsea
Farmers Rapids
Pinhey's Point
Pinks L
FORSYTH MINE
Ironside
STOP NO. 2
STOP NO. 1
Gatineau Parkway
DAWSON GRAVEL PIT
Talon
Pointe-a-Gatineau
Kettle
Rockcliffe
CANADA CEMENT QUARRY
Rockcliffe
Eastview
Fairy Lake Parkway
HULL
City Hall
Parliament Bldgs
Champlain Bridges
DESCHÊNES
Mud Pond
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Wychwood
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Location m

McArthur L
McFee L
Dodds Lake
Grand Lake
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Newton L
Poupore
Garrett L
Lac Rheaume
AFTNA MINE
BACK MINE
DAISY MINE
DERRY MINE
Glen Almond
EMERALD MINE
PEDNAUD QUARRY
CADIEUX QUARRY
NORTH
Battle L
Barnes L
Kendall L
McGregor Lake
Maskinonge L
Gilmour L
Blanche Cr
Perkins
Plumbago L
LIÈVRE
Rivière
Donaldson L
GALENA MINE
Jeanne-d'Arc
Cousineau
Blanche R
Ribot
Petite
Buckingham
McNaughton Cr
Silver Creek
Ste-Rose de-Lima
Templeton
CANADIAN
MASSON
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PACIFIC
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Angers
QUEBEC
ONTARIO
OTTAWA
Ferry
Orleans
Scale of Miles
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35
8
17

d trips

FIGURE 21. Pegmatite showing a white quartz core surrounded by a microcline zone which has, in part, been mined out (St-Pierre de Wakefield).

This quarry was worked by Canada Flint and Spar for feldspar about 10 years ago. It cuts the top of a hill and is 275 feet long, 50 to 75 feet wide and about 50 feet deep. These dimensions are not large for a quarry of this type. The pit is dwarfed by the Back and Derry mines north of Buckingham.

The quarry is in granite pegmatite – a very coarse grained rock composed almost exclusively of quartz and feldspar. Fortunately for the mine operators the minerals have been arranged in definite zones (Figure 21). Near the centre or core are several concentrations of white quartz that have been left as pillars or horses while the more valuable rock has been excavated around them. The bulk of the feldspar is pink microcline but there are local areas rich in white plagioclase, especially near the walls. Also of importance in mining is the way the rock breaks. There is a series of natural vertical fractures or joints running at right angles to the elongation of the pit. This is especially apparent in the massive quartz.

The pegmatite is a dyke that appears to be inclined towards or dips steeply to the northwest. It cuts a dark rock – amphibolite – composed of hornblende, quartz and feldspar.

It might be noted that dark minerals in the pegmatite are rare. Near the entrance to the quarry some rectangular cross-sections of black mica may be seen in haphazard arrangement. On the walls are concentrations of radioactive minerals, especially allanite and uranothorite. Someone has circled

these concentrations with white paint making them easy to locate. Observe the fractures radiating from various radioactive minerals like spokes in a wheel – a common feature associated with these minerals. Also observe how quartz and feldspar have been darkened in their immediate vicinity.

Unfortunately the quarry has been partly flooded, making access to some of the walls difficult. The provenance of minnows in this pool without inlet or outlet is a mystery.

Pegmatites were once molten rocks that intruded their surroundings but never reached the surface. Their coarse grain is usually attributed to a high content of volatile constituents such as water and phosphoric acid. The volatiles were later given off when the pegmatite cooled, although some have been preserved in hydrous minerals such as micas and rarely in phosphates such as apatite.

FIELD TRIP 6: RIVERSIDE DRIVE – LAC PHILIPPE

Road Log

Distance (miles)	
0	Baillot and Laurier streets, Hull: proceed north on Route 11;
14.8	turn right onto Riverside Drive;
17.2	Road on left to CROSS BRUCITE QUARRY.
18.7	Road on left to MAXWELL BRUCITE QUARRY.
20.8	Flashing orange light in Wakefield, turn left onto Route 11;
21.5	turn right onto Masham Road;
26.5	turn left onto Gatineau Parkway at Masham;
31.4	Parking lot at south end of Lac Philippe, trail to LUSK CAVE.

CROSS BRUCITE QUARRY

This deposit is on the property of Mr. Stephen Cross. It is west of Riverside Drive and approximately half a mile south of Farm Point. The quarry is being worked by Aluminum Company of Canada, from whom permission must be obtained before visiting. Mining only began in the fall of 1959 and the quarry face changes from day to day. The following description is therefore strictly applicable only to the time of the writer's visit (October 1960).

The brucite quarry is presently being worked from two benches, each about 20 feet high. The most striking difference between the Cross and Maxwell deposits is the coarseness of the brucite at the Cross quarry. Here brucite nodules average 2 millimeters in diameter (approximately twice the size of those from the Maxwell deposit) and may approach 5 millimeters. In addition the upper bench at the Cross quarry exposes dark pyroxene and forsterite rocks, which at the Maxwell deposit, are high on the quarry face and inaccessible.

In the lower bench a fine exposure of coarse pink syenite may be examined. This rock is composed of black hornblende and red microcline. Its joint faces

are coated with epidote. At the contact with limestone is a narrow envelope of pyroxene, scapolite, garnet and pink calcite. Here and there may be seen tiny grains of pale blue-green chlorite in the adjacent marble.

The upper bench discloses a variety of rocks. Dark forsterite crystals (almost entirely altered to serpentine) in grey calcite form the main rock type. In one place this rock held black spinel crystals ½ inch across, surrounded by fibrous pyroaurite. In another place, hard pink kernels of hydrotalcite were observed in the serpentine 'pseudomorphs'. Serpentine-limestone and pyroxenite are also exposed. A lens of granular diopside, 10 feet across, has partly weathered to a grey sand. The syenite also outcrops on this bench and, in one place, contains molybdenite flakes.

MAXWELL BRUCITE QUARRY

Maxwell brucite quarry is off Riverside Drive about 2 miles south of Wakefield. Permission for access must be obtained from the operator, Aluminum Company of Canada. The material sought is brucite which occurs in marble as nodules, each about a millimeter across. On a fresh surface brucite is approximately the same white colour as the surrounding calcite. Fortunately the brucite weathers into pits that are commonly partly filled with chalky magnesium carbonates and therefore give a clue to the amount of brucite below. Rarer, and of no economic importance, is colourless 'foliated brucite' which occurs as plates on joint surfaces. Rarer still are coarse fibres of brucite which cross veinlets.

The quarry exposes a number of other rock types which, when present in sufficient quantity, form boundaries of the orebody. On the southeast wall may be seen large infolded masses or roof pendants of an overlying dark-coloured layer (Figure 22). These rocks were once comparatively brittle, and instead of bending and flowing with the crystalline limestone as it was deformed, they broke and separated into isolated parts. In the pyroxene-rich rocks or pyroxenites are cores of pink calcite. The calcite contains amber mica (phlogopite) and green apatite which was once mined from shallow pits above this section of the quarry. The arch-like folds are anticlines and the troughs are synclines. On the west side of this face is an upfolded remnant of grey syenite – the rock which underlies the deposit. This is part of the Wakefield syenite, the same syenite mass that outcrops in the northern and central part of the Gatineau Park. A yellowish green rock is serpentine-rich limestone. Associated with the serpentine is a granular pyroxene (diopside) that is quite different in appearance from the long dark crystals of pyroxene in the infolded pyroxenite masses. The granular pyroxene is green, sky-blue or mauve.

The ramp leading into the quarry on its west side passes several interesting features. Near the top are grooved fault surfaces, or slickensides, smoothed when rocks slipped along fractures. Lower down is a grey syenite surrounded by an envelope of hard pyroxene and stringers of calcite. Then there are veins of pink calcite holding green apatite crystals. Somewhat lower are serpentine masses, some enclosing diopside, pyrrhotite and pyrite. Near the

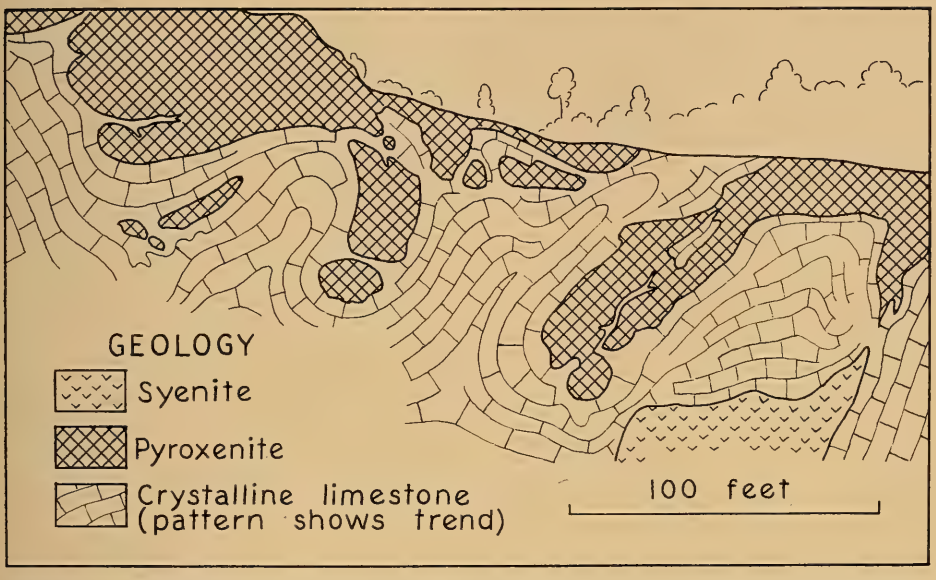

FIGURE 22. Geological section along the south face of the Maxwell quarry, showing roof pendants of pyroxenite in crystalline limestone.

bottom of the ramp are black crystals of forsterite, nearly completely replaced by serpentine, in grey and mauve calcite.

The quarry is remarkable for the multitude of minerals which may be collected. Besides those already mentioned we may list the following: hydromagnesite (pulverulent white), pyroaurite (white pulverulent and fibres), hydrotalcite (nodules in serpentine), aragonite (stalactitic), graphite (occasional coarse flakes), chrysotile asbestos, talc, specularite and rare sphalerite, galena, celestite, rutile and chondrodite. Spinel, periclase and vesuvianite, while reported, have not been seen by the writer.

According to Goudge (1939) the brucite (magnesium hydroxide) was developed from Precambrian dolomite (calcium and magnesium carbonate) by the heat derived from the intruding molten syenite. The brucite limestone contains essentially brucite and calcite (calcium carbonate). Its composition differs little from an average Precambrian dolomite; only water need have been added.

LUSK CAVE

Lusk Cave may be reached by taking the road to the lower (southeastern) end of Lac Philippe via Masham. A marked and well-worn trail leads uphill half a mile to the cave. The cave does not contain any well-defined chambers but is rather a tortuous tunnel with alternate passages and blind alleys. It forms an underground route for the stream that drains Lusk Lake. It is divided into two by a caved-in part or sink.

The upper half of the cave begins with a bridge 60 feet wide. The passageway from there is skylit by a number of natural wells which extend

from the surface 20 or 25 feet to the base of the cavern. The remaining part is subterranean. This section is about 200 feet long (measured in a horizontal straight line). The lower half of the cave includes steep plunges and waterfalls. It crosses an area 150 feet long. Unfortunately, the exit is underwater.

Lusk Cave crosses an exceptionally coarse band of pink and grey crystalline limestone. The direction of channelling was controlled by the layering of the limestone and a joint system almost at right angles to it. The cave zig-zags along these preferred directions. The limestone contains inclusions of pegmatite, biotite gneiss and pyroxenite. Rapids and waterfalls occur where the stream crosses narrow ridges of hard pegmatite. At the surface, on the scarp leading down to the cave exit, may be seen whitish syenite (mottled pink when freshly broken) passing downward into greenish black pyroxenite and finally grey crystalline limestone. For further details see Kirwan (1961).

FIELD TRIP 7: MASSON – ROUTE 35

Road Log

Distance (miles)	
0	Baillot and Laurier Streets, Hull: proceed east on Route 8;
18.1	MASSON: Unconformity and potholes.
18.4	turn left onto the Buckingham Highway (Route 35);
29.2	Road to CADIEUX QUARTZITE QUARRY on left.
29.8	Road to PEDNAUD FELDSPAR MINE on right.

MASSON: UNCONFORMITY AND POTHOLES

This locality is on the west side of the Lièvre River between Route 8 and the CPR tracks. It is best examined in late summer or early fall when the bed of the river is dry. Precambrian and Ordovician (Nepean) formations are well exposed, having been swept clean by turbulent water.

The principal rocks are of Precambrian age. Crystalline limestone is very common but pegmatite, gneiss, schist and quartzite may also be found. The beds dip steeply, generally at an angle greater than 45 degrees to the horizontal. Locally the plastic limestone flowed under pressure and engulfed fragments of more brittle rocks.

The Precambrian is blanketed by the flat-lying Nepean Sandstone. Most of this sandstone has since eroded away. A conglomerate of varying thickness occurs at its base. The pebbles are generally smaller and occur in greater profusion than inclusions in the crystalline limestone. They are almost exclusively quartzite; only within an inch or two of the Precambrian are fragments and pebbles of crystalline limestone and gneiss to be found. At the base of certain pebble beds, larger fragments have lodged in depressions.

It is obvious that considerable time elapsed between the deposition of Precambrian limestone and Nepean Sandstone. At least one period of deformation and metamorphism separated the two. The limestone, which

FIGURE 23. Potholes in crystalline limestone (Masson).

probably once resembled that quarried in Ottawa, has been tilted and subjected to metamorphism. The calcite grains became very coarse and new minerals such as pyroxene and mica were formed. The overlying sandstone is horizontal and has not been transformed into quartzite. Furthermore, sandstone is found at different levels, suggesting deposition on an ancient eroded surface. The well-rounded quartzite pebbles at its base have been derived from a formation that is not now evident. We have here a good example of an unconformity — a term used to describe the relationship of formations separated by a great period of time.

Fine examples of well-like potholes (Figure 23) may be seen in Ordovician and Precambrian formations. These are generally about a foot in diameter. They have been drilled by pebbles circulated in the eddies. Pebbles still remain at the base of most potholes.

An interesting locality (Figure 24) is just north of Route 8. A 15-foot cliff of sandstone marks the west bank of the Lièvre. Below is a horizontal shelf of conglomerate which extends 50 feet into the river bed but is less than a foot thick in most places. It is penetrated by potholes which expose pink crystalline limestone at their base. Farther north, two crevices in crystalline limestone have been filled with conglomerate and have the appearance of dykes.

Small exposures of unconformities can be seen at the west side of Wabassi or Beauchamp Lake (Nepean Sandstone — Precambrian granite) and along an

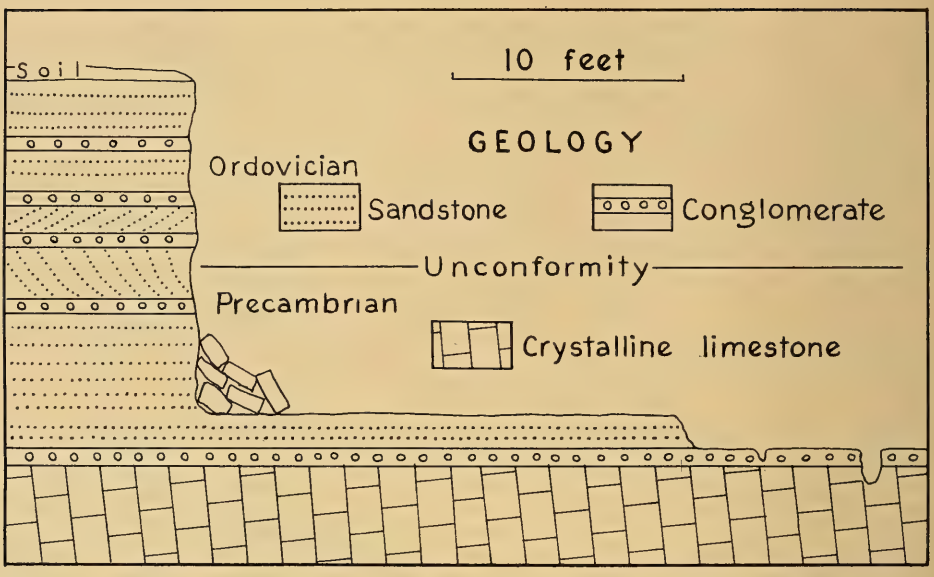

FIGURE 24. Geological cross-section of an unconformity (Masson).

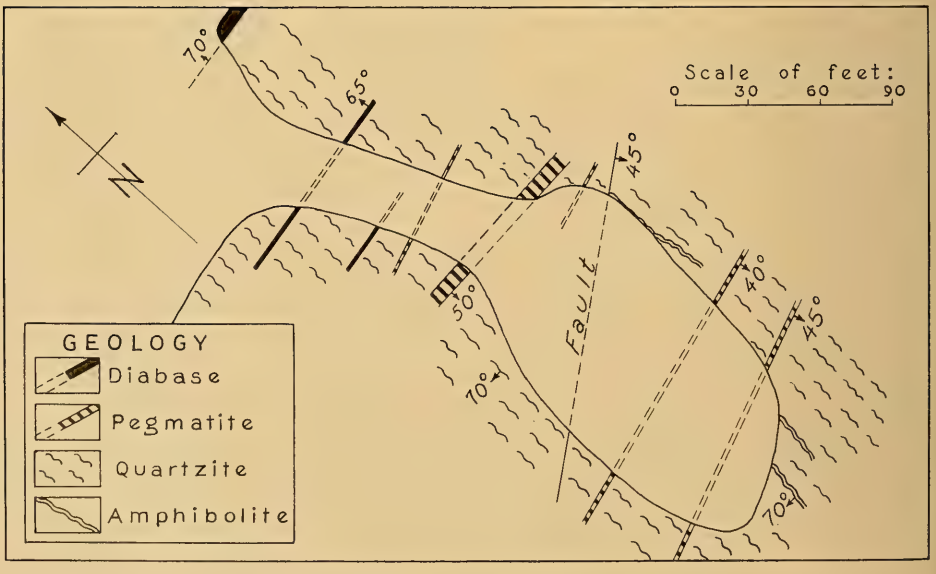

FIGURE 25. Geological plan of the Cadieux quartzite quarry.

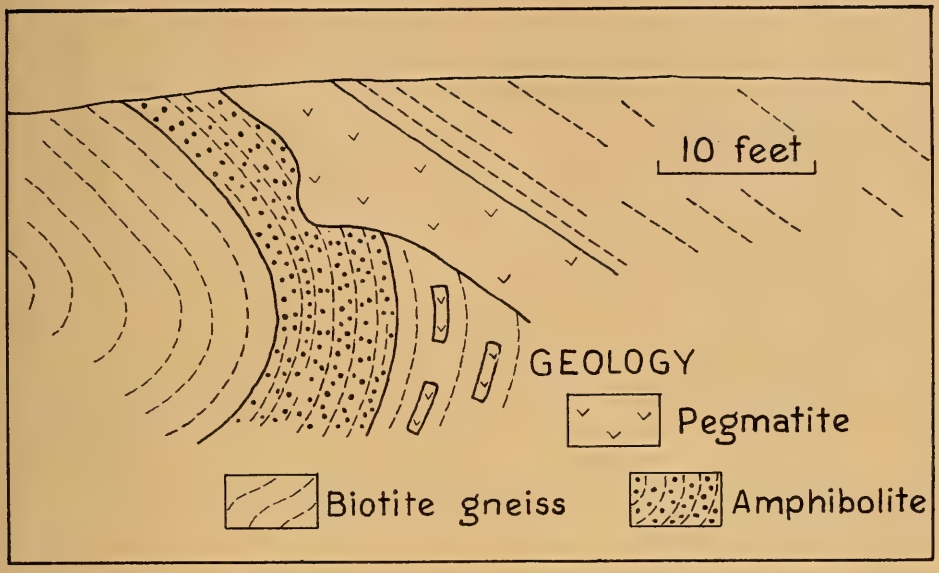

FIGURE 26. Geological cross-section of part of the Cadieux quartzite quarry.

abandoned railway west of Ste. Rose de Lima (Nepean Sandstone – Precambrian quartzite).

CADIEUX QUARTZITE QUARRY

Turn left off the Buckingham Highway 10.8 miles north of Masson. A gravel road leads to the quarry. This quarry is owned by Mr. Omer Cadieux of Buckingham and was worked in 1955 to supply silica to the Electric Reduction Company.

The quarry is remarkable for its good exposures of dykes (Figure 25). These dykes are narrow but most can be picked up on both sides of the quarry. At the entrance is a dark diabase dyke whose north contact is exposed. Note how the grain size becomes very fine near the contact. This can be ascribed to rapid chilling of the molten rock by quartzite. Two narrower diabase dykes are easily located by virtue of their black colour.

Coarse pink pegmatite dykes are more common. The largest one (7 feet wide) appears near the quarry-widening. In its forceful intrusion it has dragged the metamorphic rocks on its footwall through 90 degrees (Figure 26). The hanging wall has not been drag-folded but is noticeably sheared parallel with the dyke contact.

These pegmatite dykes are composed mainly of quartz and microcline, but instead of the common dark silicate minerals (such as hornblende or biotite) a little magnetite is present; biotite is comparatively rare. It will be noticed that the dykes are arranged in two parallel series, the diabase dykes dipping north at 70 degrees. the pegmatites south at about 50 degrees.

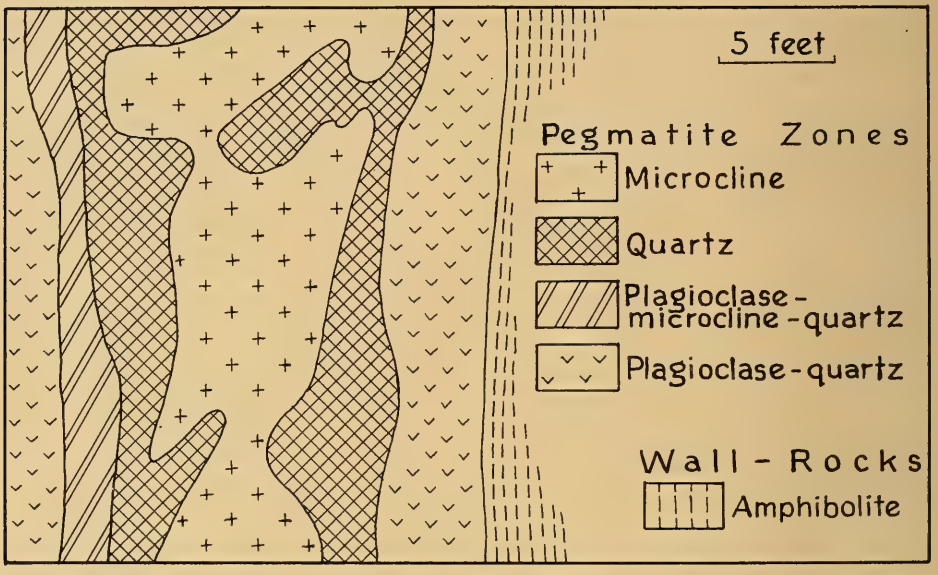

FIGURE 27. Geological cross-section of the pegmatite at the Pednaud mine.

Faults are also apparent. On the east side of the quarry is a dark rock – amphibolite – composed of quartz, hornblende and mica. On its lower side, the stratum is abruptly cut off by a fault which has deformed the plastic amphibolite along a shear zone 6 inches wide. Quartzite nearby has fractured irregularly but many of these fractures have been healed. The fracture zone is also apparent on the west side of the quarry.

PEDNAUD FELDSPAR MINE

The Pednaud feldspar mine is off the Buckingham Highway, 11.4 miles north of Masson. Turn right at the sign "Chalet des Monts Ski Tow" and continue 1 mile to the mine. The property is presently owned and operated by Mr. F. Charette of Glen Almond.

The feldspar dyke has been mined in two sections, each from pits about 250 feet long. The lower quarry is now (October 1960) being worked for microcline, which occurs in a narrow zone in the centre of the dyke.

The abundance of coarse white mica (muscovite) is remarkable and in this respect the occurrence is similar to the famous Villeneuve mine, 12 miles to the northeast. Biotite is relatively uncommon.

Here is a good example of a zoned pegmatite (Figure 27). Near the walls is a medium-grained quartz-plagioclase-muscovite zone where individual mica books up to 15 inches across have been found. This is followed by a plagioclase-microcline-quartz zone which is not everywhere present. In the centre is a very coarse zone (or zones) of quartz and microcline. Zoning of

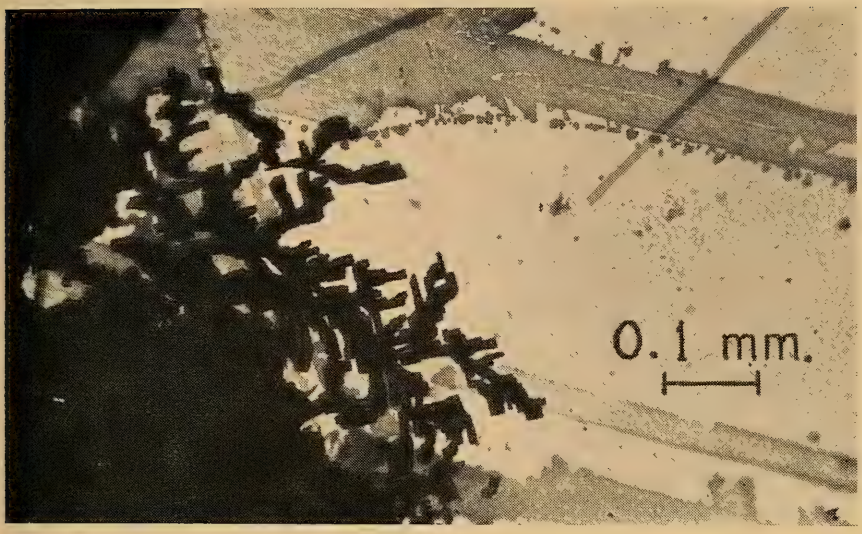

FIGURE 28. Muscovite as seen under the microscope. The black inclusions are magnetite crystals (Pednaud mine).

pegmatites has been the subject of much investigation. The zones are believed to have been deposited successively inward from the molten rock.

Magnetite impurities in muscovite are arranged in an interesting manner. A thin slice of mica held to the light reveals a triangular pattern of fawn needles and interspersed dark brown dots. Under the microscope (Figure 28) the dots appear to be made up of tiny crystals with edges parallel to the same triangle. The brown stains preclude the use of this mica in electronics.

Abundant black tourmaline, muscovite and patches of clay-like chasmosite occur with the microcline. Comparatively uncommon minerals include pyrite, garnet, hornblende, epidote, chlorite and hematite. Very rare are calcite, chabazite, monazite, uraninite, uranothorite, apatite and barite.

A number of other mines occur near Glen Almond (Figure 29). The Aetna and Daisy phosphate mines are largely grown over. A look at another old phosphate mine, the Emerald, is somewhat more rewarding; but the deep pits are walled with rotten rock and therefore very dangerous. The Derry feldspar mine is now flooded but the Black mine is operated by Canada Flint and Spar. This last occurrence contains a little euxenite – a heavy coal-black radioactive mineral – on its dumps. Neither the Derry nor the Back mine contains appreciable muscovite.

SOME ADDITIONAL FIELD TRIPS

Other interesting sites include the Foley barite mine, the Haycock iron mine and the Buckingham galena mine. These places are too small to accommodate a large number of visitors and parking facilities are limited; but they can be easily examined by a small group.

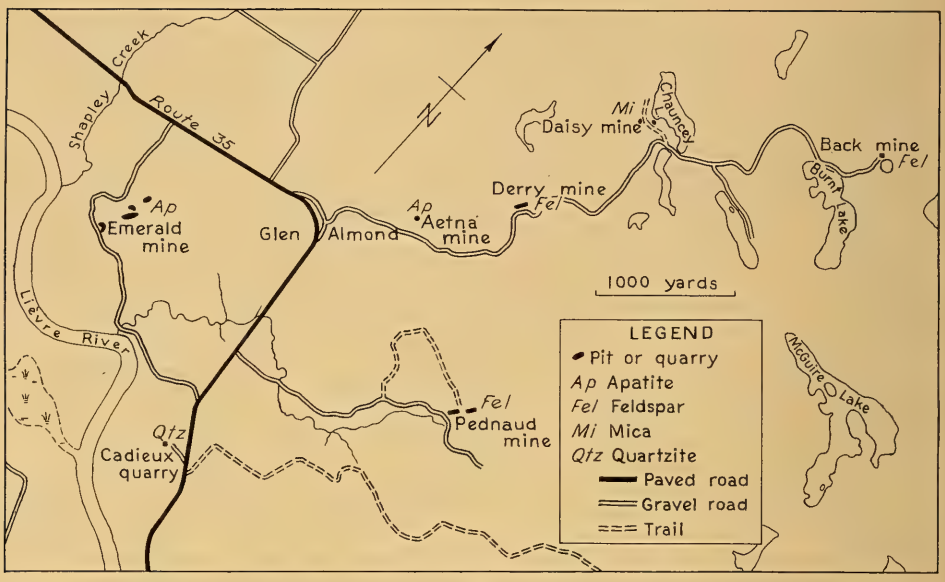

FIGURE 29. Map showing mines and quarries in the Glen Almond area.

HAYCOCK HEMATITE MINE

The Haycock iron mine may be reached in the following manner: Take Route 8 to Pointe-Gatineau and turn left just after the bridge. Continue for 2.25 miles and turn right. At the next intersection (1.1 miles) take the left-hand fork and proceed 2.1 miles north to a concession road. Turn right, proceed 0.65 mile and again turn left. After 2.7 miles the trail to the mine leads left just before a small creek. (The trail is marked by a pile of logs). The mine dumps can be seen to the north of this trail, $\frac{3}{8}$ mile from its entrance.

The workings here are the largest of several along the Hull-Templeton line, extending from range 10 of Hull township to Rainville Creek, a distance of 6 miles. The iron mineral is a bright crystalline hematite or specularite that occurs in pink feldspar gneiss. Specularite is seen as disconnected pods with a maximum width of about 2 feet. Associated with the hematite is a little ilmenite and magnetite. A peculiarity of the hematite is its high content of titanium (up to 15 per cent TiO_2). With an increase in titania the streak darkens almost to black.

Plums of specularite are common where the gneiss has been fractured and recemented. Specularite is commonly enclosed in quartz between fragments rich in dark green pyroxene. Grey barite and pink calcite are frequently seen with the specularite, especially in the mine dump at the east of the Haycock. mine.

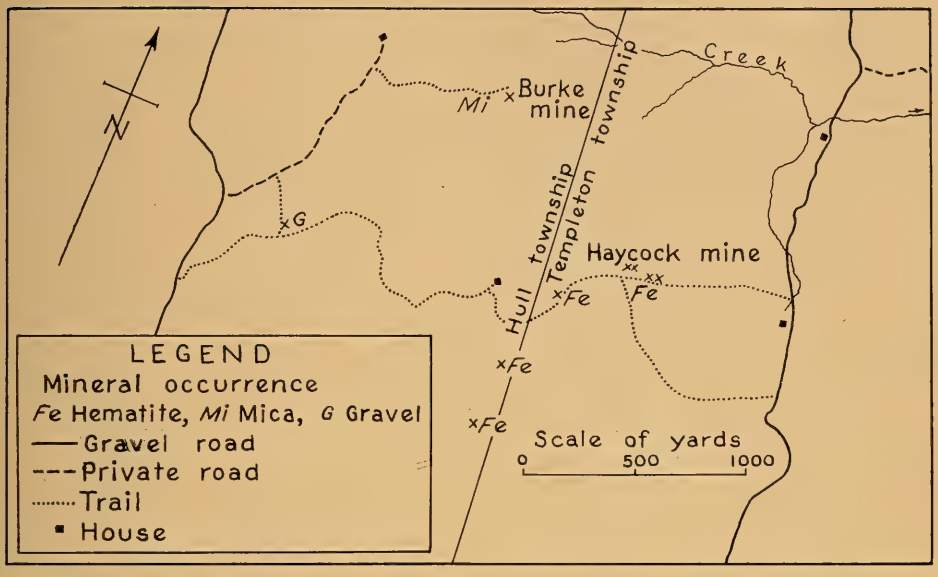

FIGURE 30. Map showing the Haycock locality and nearby mineral occurrences.

Geologically the occurrence is interesting because pods of titanium-rich hematite are liberally dispersed along layers of a quartz-feldspar gneiss. The coarsest specularite is found in boulders north of a field about 500 feet west of the Haycock mine. Magnetite octahedra, ½ inch across, are rarely found in calcite. Brilliant prisms of green pyroxene up to ½ inch in diameter occur in calcite and barite close to hematite. A granular pink quartz is attractive.

Pits at the Haycock site extend over a length of 300 feet. The two largest ones are north of the dump at the east. Each is about 50 feet long and 20 feet wide but unfortunately are filled with water. A small adit, apparently driven as a drainage tunnel, was abandoned after 15 feet. Near the west part of the Haycock mine is a walled circular structure 35 feet across. This was probably a charcoal kiln used for making lime. Nothing remains of the railway constructed to transport ore to Pointe-Gatineau.

The Burke mica mine is about a mile to the west (Figure 30). It is comparatively hard to reach, the best approach being from the next lot-line road to the west. The mine has long been abandoned. As at the Dacey mine, phlogopite and apatite occur in pink calcite. Notable is dark pyroxene in coarse cleavable masses of basal parting. Parting surfaces 1 foot across have been found on the dump.

FOLEY BARITE MINE

The Foley mine is east of the Cantley Road. Turn right off this road at a point 2.6 miles above the Limbour Bridge and proceed 0.8 mile on a good gravel road to the mine. The road is bridged across the open pit at the property of

G. Clermont. On each side of the road the pit is enclosed in a cluster of cedars.

The Foley barite occurrence was worked many years ago by the Montreal Paint Company, and workings are now largely grown over. The trench can be traced for 200 feet on the north side of the road where it terminates in a shaft, and on the south side of the road for 150 feet. At a rather inaccessible locality near the southern end, the vein measured 3.6 feet wide. Here the vein is not solid white barite but includes 'horses' of pink limestone and is interbanded with fluorite and occasionally calcite and dolomite. It cuts across pink biotitic limestone almost at right angles to the foliation. The vein dips nearly vertically. In places it cuts pegmatite. Small grains of galena, sphalerite, pyrite and chalcopyrite are in many places embedded in barite at the north side of the road.

Barite veins containing varying amounts of galena are common in the Gatineau region. They are known to be late in the geological sequence – certainly later than diabase which they sometimes transect. They perhaps do not belong in the Precambrian at all. A galena vein cuts much younger (Palaeozoic) rocks near Carleton Place, and barite-fluorite veins transect Palaeozoic limestone near Madoc. Other barite veins may be seen north of the intersection of the Meach Lake and Kingsmere roads (pink barite) and at the intersection of the Notch and Mountain roads (white barite).

Buckingham Galena Occurrence

The Buckingham galena property is on the farm of Mr. Dan Gorman. It can be reached in this manner: Take Route 8 from Hull to Masson, turn left at the Esso service station just before the Lièvre bridge and continue north for 2.5 miles. Turn left on the concession road at Phillion's store; after 3.0 miles turn right at a road leading north and proceed ½ mile to the farm of Mr. Gorman (left-hand side of the road). The barite-galena veins are in a pasture just north of the farm buildings. A shaft on the main vein is marked by a clump of cedars.

Many barite occurrences may be seen in this field. The two principal veins are about 80 feet apart and have been exposed by trenches. These veins cut crystalline limestone and dip almost vertically. Each can be followed north-westerly for about 340 feet. Here they enter pegmatite and are obscured by swamp.

The veins are composed of coarse white calcite and barite, with a maximum width of 6 inches. Most carry appreciable galena in places as well as a little sphalerite, pyrite and pyrrhotite. The galena is occasionally covered with a white coating of lead carbonate (cerussite). At one locality calcite has been dissolved away, exposing crystals of barite carrying a few white octahedra of fluorite.

The pits were excavated many years ago and the dumps are now largely grown over. However, the vein is still exposed in a number of places. Handsome specimens of barite enclosing brilliant galena cleavage surfaces up to ½ inch across, can still be obtained.

PART THREE

MINERALS AND MINERAL VARIETIES FOUND IN THE REGION

Actinolite	Chrysotile	Labradorite	Sahlite
Adularia	Columbite	Limonite	Samarskite
Aegirine	Cordierite	Magnetite	Scapolite
Albite	Cyrtolite	Malachite	Serpentine
Allanite	Datolite	Microcline	Sillimanite
Almandine	Diopside	Molybdenite	Specularite
Amazonite	Dolomite	Molybdite	Sphalerite
Andradite	Epidote	Monazite	Sphene
Apatite	Euxenite	Montmorillonite	Spinel
Apophyllite	Faujasite	Muscovite	Talc
Arfvedsonite	Ferroprehnite	Natrolite	Thorite
Augite	Fluorite	Oligoclase	Tourmaline
Barite	Forsterite	Olivine	Tremolite
Betafite	Galena	Periclase	Uraninite
Biotite	Graphite	Phlogopite	Uranothorite
Brucite	Gypsum	Prehnite	Uvarovite
Calcite	Hematite	Pumpellyite	Vermiculite
Celestite	Hornblende	Pyrite	Vesuvianite
Cerussite	Hydromagnesite	Pyroaurite	Wilsonite
Chabazite	Hydrotalcite	Pyrrhotite	Wollastonite
Chalcopyrite	Ilmenite	Quartz	Zinnwaldite
Chamosite	Jasper	Rutile	Zircon
Chlorite			

Except for columbite, faujasite, samarskite, periclase and uvarovite, these minerals have all been observed by the writer.

A KEY TO THE COMMON MINERALS OF THE GATINEAU-LIEVRE DISTRICT

The following identification table or key is based on colour, cleavage and crystal form. The primary distinction is that of colour because this property, so easily recognized, is diagnostic. However, it should be emphasized that this key relates only to minerals found within the particular area covered by the report and the colours given may not be characteristic for the same minerals in other areas.

Cleavage is the tendency of a solid to split along specific planes determined by the arrangement of its atoms. Some minerals have one cleavage, others two, and still others up to six. When four or more cleavage planes occur in a crystal they may not all be identifiable in a single specimen. For example, in broken crystals of black andradite the six cleavage or 'parting' planes can rarely be found but usually four or five planes can be seen. When two or more cleavage directions are present the angles at which they intersect may be of great assistance in identification.

Certain minerals appear more than once in the key. For example, scapolite may occur as a green, purple or white mineral but the properties of each colour variety are distinctive. Green scapolite is soft and rarely found as crystals; purple scapolite is soft and occurs as cleavable masses; but white scapolite is a little harder and commonly occurs as crystals.

Only about one third of the local minerals are included. However, these represent the most abundant and typical minerals.

KEY

A. Mineral is brassy.
No cleavage, crystals equidimensional;
powder black, non-magnetic . . . . . PYRITE

B. Mineral is bronzy.
No cleavage, massive;
powder black, attracted to a hand-magnet . . . . . PYRRHOTITE

C. Mineral is silvery.
(1) No distinct cleavage;
powder brownish red to brownish black;
about as hard as a knife-blade . . . . . HEMATITE
(2) Perfect cleavage in platelets;
occurs as foliae or flakes;
(i) powder grey, olive-green when rubbed into paper;
softer than finger-nail, foliae inflexible . . . . . MOLYBDENITE
(ii) powder lead-grey;
softer than finger-nail, foliae inflexible . . . . . GRAPHITE
(iii) powder white;
harder than finger-nail, foliae flexible;
occurs with calcite, sahlite, apatite . . . . . PHLOGOPITE
occurs with quartz and feldspar . . . . . MUSCOVITE
(iv) powder brown (generally reddish brown);
harder than finger-nail . . . . . SPECULARITE

D. Mineral is grey to black.
(1) Good cleavage in six directions, crystals equidimensional;
light and non-magnetic, harder than a knife-blade;
occurs with quartz and feldspar in pegmatite . . . . . ANDRADITE
(2) Good cleavage in four directions, crystals equidimensional;
about as hard as a knife-blade, heavy and strongly magnetic . . MAGNETITE
(3) Two good cleavages intersecting at 60 and 120°;
occasionally occurs as elongated crystals;
about as hard as a knife-blade, jet-black . . . . . HORNBLENDE
(4) Good cleavage in one direction, poor cleavage in two others;
stubby grey crystals;
about as hard as a knife-blade . . . . . SAHLITE
(5) Good cleavage in one direction; crystals as foliae, occasionally massive;
softer than finger-nail, brittle . . . . . GRAPHITE
(6) Cleavage very poor to absent; crystals tabular;
dull grey, commonly with olive-green patches;
harder than a knife-blade (when fresh);
occurs in crystalline limestone . . . . . FORSTERITE
(7) Cleavage absent; elongated crystals striated along length;
harder than a knife-blade, jet-black;
occurs with quartz and feldspar in pegmatite . . . . IRON-TOURMALINE
(8) Cleavage absent; short crystals with some faces striated;
harder than a knife-blade, jet-black to brown;
occurs in crystalline limestone and pyroxenite . . MAGNESIUM-TOURMALINE

E. Mineral is green.

(1) Good cleavage in four directions; commonly occurs as cubes
can be scratched with a knife, translucent . . . . . FLUORITE

(2) Good cleavage in two directions intersecting at 60 and 120°;
long crystals, dark yellow-green;
about as hard as knife-blade . . . . . ACTINOLITE

(3) Good cleavage in two directions intersecting at 60 and 120°;
long crystals, dark blue-green;
about as hard as a knife-blade . . . . . ARFVEDSONITE

(4) Good cleavage in one direction, poor cleavage in two others;
stubby crystals, light greyish green;
slightly softer than a knife-blade . . . . . SAHLITE

(5) Good cleavage in two directions intersection at 90°;
crystals rare; light-coloured braided streaks;
about as hard as a knife-blade . . . . . ('AMAZONITE') MICROLINE

(6) Poor cleavage in four directions giving splintery appearance;
rarely in elongated crystals, pale green;
softer than a knife-blade . . . . . SCAPOLITE

(7) Cleavage absent or poor cleavage in one direction;
sugary-textured or as long six-sided crystals;
slightly softer than a knife-blade;
occurs with calcite, sahlite, scapolite . . . . . APATITE

(8) No cleavage; long crystals striated parallel to length;
cannot be scratched with a knife . . . . . IRON-TOURMALINE.

(9) No cleavage; massive;
can easily be scratched with a knife;
occurs in crystalline limestone and dolomite . . . . . SERPENTINE

(10) Flexible asbestos fibres;
occurs in crystalline limestone and dolomite . . . ('ASBESTOS') SERPENTINE

F. Mineral is brown.

(1) Two good cleavages intersecting at 55 and 125°;
wedge-shaped crystals, dark brown;
about as hard as a knife-blade . . . . . SPHENE

(2) Good cleavage in one direction; occurs as mica foliae;
softer than a knife-blade;
occurs with calcite, sahlite and apatite . . . . . PHLOGOPITE

(3) Cleavage absent or poor cleavage in one direction;
long six-sided crystals;
softer than a knife-blade;
occurs with sahlite and phlogopite . . . . . APATITE

(4) Cleavage absent; short crystals with some faces striated;
harder than a knife-blade;
occurs in crystalline limestone . . . . . MAGNESIUM-TOURMALINE

(5) Cleavage absent; crystal form absent;
shell-like fracture, reddish brown;
harder than a knife-blade . . . . . JASPER
pulverulent, brick-red . . . . . HEMATITE
pulverulent, rust-brown . . . . . ('LIMONITE') GOETHITE

G. Mineral is pink or orange.

(1) Good cleavage in three directions intersecting at 75°;
crystals absent, effervesces in vinegar;
softer than a knife-blade . . . . . CALCITE

(2) Good cleavage in three directions, two intersecting at 90°, the other at 80° to these;
occurs as tabular crystals;
heavy, pale pink;
softer than a knife-blade . . . . . BARITE
(3) Good cleavage in two directions intersecting at 90°;
crystals rare, light-coloured braided streaks;
about as hard as a knife-blade . . . . . MICROLINE
(4) Cleavage absent or poor; rounded equidimensional crystals;
deep red or purple;
harder than a knife-blade;
occurs in gneiss or schist . . . . . ALMANDITE
(5) Cleavage absent; massive;
resembles tinted glass;
pale rose;
harder than a knife-blade . . . . . ROSE QUARTZ

H. Mineral is purple.
(1) Good cleavage in four directions; commonly occurs as cubes;
translucent deep purple;
softer than a knife-blade . . . . . FLUORITE
(2) Poor cleavage in four directions giving splintery appearance;
cleavable masses; light mauve;
softer than a knife-blade;
occurs with apatite, phlogopite and sahlite . . . ('WILSONITE') SCAPOLITE

I. Mineral is blue.
(1) Cleavage absent or poor in one direction; long six-sided crystals or massive;
aquamarine (crystals), greenish-blue (massive);
slightly softer than a knife-blade;
crystals found in marble, massive variety with sahlite . . . . APATITE
(2) No cleavage; massive;
impure, harder than a knife-blade;
full of inclusions and holes;
light blue, with apatite and sahlite . . . . . QUARTZ

J. Mineral is white or colourless.
(1) Good cleavage in three directions intersecting at 75°;
six-sided crystals, pyramidal;
effervesces with vinegar;
softer than a knife-blade . . . . . CALCITE
(2) Good cleavage in three directions, two intersecting at 90°, the other at 80° to these;
occurs as tabular crystals;
softer than a knife-blade, heavy . . . . . BARITE
(3) Cleavage in two directions intersecting at 90°;
crystals rare;
occasionally striated on best cleavage;
may show play of colours;
about as hard as a knife-blade . . . . . PLAGIOCLASE
(4) Good cleavage in one direction, poor in two others;
stubby white or very pale green crystals;
about as hard as a knife-blade . . . . . DIOPSIDE
(5) Poor cleavage in four directions, giving splintery appearance;
commonly occurs as elongated crystals with square cross-section;
weathering gives 'woody' appearance;
somewhat softer than a knife-blade . . . . . SCAPOLITE
(6) No cleavage; occasionally occurs as six-sided crystals;
harder than a knife-blade . . . . . QUARTZ

GLOSSARY OF SELECTED TERMS

ADIT. A tunnel driven into the side of a hill for exploring of mining a mineral deposit.

AMPHIBOLE. A group of dark-coloured, rock-forming minerals including tremolite, actinolite and hornblende, which commonly occur as shiny, green, needle-like crystals.

AMPHIBOLITE. A metamorphic rock composed essentially of hornblende and plagioclase.

ANTICLINE. A fold that is convex upward.

APLITE. A sugary-textured rock composed of quartz and feldspar.

ASTERISM. The ability of certain minerals to concentrate light into star-like rays.

BLACK RIVER. A Middle Ordovician formation.

BRECCIA. A rock consisting of angular fragments cemented by finer material.

BRYOZOAN. A colonial animal which builds cylindrical, cup-like or branching structures.

CHAMPLAIN SEA. A sea that extended up the Ottawa Valley after the final recession of the Pleistocene glaciers.

CHILLED CONTACT. A fine-grained part of an igneous rock close to its contact with another rock. Its fine-grained nature is believed to have been caused by rapid cooling.

CONGLOMERATE. A rock consisting of rounded, water-worn fragments cemented by finer material.

CROSSBEDDING. Lamination oblique to the principal direction of bedding of a sedimentary rock.

CRYSTAL. A solid body bounded by smooth faces that are related to an ordered internal arrangements of atoms.

DIABASE. A dark-coloured igneous rock consisting of rounded pyroxene grains intersected by tabular feldspar crystals. In the Gatineau-Lièvre region it occurs as dykes.

DIP. The inclination of a statum measured downward from the horizontal.

DOLOMITE. A rock corresponding in composition to the mineral dolomite [$CaMg(CO_3)_2$].

DRIFT. Unconsolodated material such as sand, clay or gravel deposited by a glacier or its meltwaters.

DRUMLIN. A teardrop-shaded hill of glacial drift moulded by the action of ice so that its long axis parallels the direction of ice-movement.

DYKE. A tabular body of igneous rock that cuts across the stratification or structure of the enclosing rocks.

ESKER. A sinous ridge of drift generally believed to have been deposited by rivers flowing beneath a glacier.

FAULT. A fracture along which movement has taken place.

FOOTWALL. The lower wall of a fault, dyke or vein.

GNEISS. A foliated and coarsely crystalline metamorphic rock.

GRADED BEDDING. Stratification in which each layer grades from coarse at the bottom to fine at the top.

GROUND MORAINE. Material carried within and at the base of a glacier and deposited as the ice receded.

HANGING WALL. The upper wall of a fault, dyke or vein.

IGNEOUS. A rock solidified from the molten state.

JOINTS. Fractures separating rocks into blocks.

KETTLE. A depression in drift formed by the melting of a buried block of ice.

LIMESTONE. A sedimentary rock composed essentially of calcite. Recrystallized and metamorphic limestones are called crystalline limestones or marble.

MARBLE. A metamorphic rock composed predominantly of calcite.

METAMORPHIC ROCK. A rock that has been transformed by agencies of heat and pressure.

MINERAL. A naturally-occurring inorganic solid of reasonably constant chemical composition and atomic structure.

MORAINE. Accumulated debris deposited by a glacier.

OCTAHEDRON. An eight-sided crystal form with each face an equilateral triangle and common in pyrite, magnetite, galena and fluorite.

ORDOVICIAN. A period in the earth's history lasting from about 500 to 400 million years ago.

PARTING. The quality of a crystal to split along certain planes which are not normally cleavage planes.

PEGMATITE. A very coarse grained igneous rock, generally of granitic composition.

PHOSPHATE. The mineral apaite (colloquial).

PLEISTOCENE. An epoch extending from about 1,000,000 to 10,000 years ago when an ice-cap covered most of North America.

POTHOLE. A hole with circular cross-section that was drilled in solid rock by stones rotating in a river current.

PRECAMBRIAN. A period in the earth's history before the Cambrian and ending about 500 million years ago.

PSEUDOMORPH. A mineral displaying the crystal from of another mineral species from which it was derived by alteration or replacement.

PYROXENE. A group of rock-forming minerals including diopside, augite and sahlite, which occur as stubby black or green crystals.

PYROXENITE. A rock composed essentially of pyroxene but commonly including considerable amounts of amphibole, mica, scapolite and other minerals. Pyroxenites near Ottawa have been classed by some authors as igneous rocks, by others as metamorphic rocks.

QUARTZITE. A compact metamorphic rock composed essentially of quartz.

ROCK. Material composed of one or more minerals and occurring in large masses.

ROOF PENDANT. Older rocks preserved as (folded) masses projecting downward into an igneous rock.

SANDSTONE. A sedimentary rock composed essentially of grains of quartz.

SCHIST. A well-foliated metamorphic rock predominantly composed of micaceous minerals.

SEDIMENTARY ROCKS. Rocks laid down as sediments from water or air.

SILICATED MARBLE. Marble containing silicates such as pyroxene, amphibole or garnet, formed by reactions during metamorphism.

SILL. A tabular body of igneous rock interlayered with the stratification or structure of the enclosing rocks.

SINK. A depression resulting from solution of limestone.

STALACTITE. An icicle-like deposit of mineral matter on the roof of a cave.

STALAGMITE. An inverted 'icicle' of mineral matter rising from the floor of a cave.

STOPE. An underground opening from which ore has been taken.

STRATIFICATION. Layering in sedimentary rocks.

STREAK. Colour of the powder of a mineral which is best seen by scratching the mineral on a piece of unglazed white tile.

STRIKE. The line of intersection of a plane with a level surface.

SYENITE. A rock composed of microcline, albite, or both, and a dark mineral.

SYNCLINE. A trough-like fold or downfold.

TILL. A glacial deposit consisting of clay rich in boulders.

TRENTON. A formation of Middle Ordovician age.

TRILOBITE. An extinct invertebrate whose body can be divided into three parts or lobes.

UNCONFORMITY. A time-break or surface of erosion associated with this time-break.

VUG. A cavity in rock commonly lined with well-formed crystals.

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OBSERVATIONS ON SOME MAMMALS IN CUMBERLAND PENINSULA, BAFFIN ISLAND, IN 1953

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THIS PAPER records my observations on the mammals seen on Baffin Island in 1953. The occasion was on an expedition for the Arctic Institute of North America. This expedition visited the mountainous Cumberland Peninsula on the east coast of the island, at about 67°N. There are brief accounts about the weather, vegetation and topography of this area in the general report on the expedition by Baird (1953). I have published notes on the lemmings *Lemmus* and *Dicrostonyx* (Watson, 1956).

In May I sledged along the east coast and fjords around Padloping, and in early June up the long Padle Fjord to Padle Valley. From June to August I worked in Owl Valley, the northern part of Pangnirtung Pass, which cuts right through the mountains and icecaps of the peninsula. Two passes run eastward from Owl Valley to the June and Naksakjua valleys, which lead to Padle Valley. The southern part of the pass leads down to the fjord near the village of Pangnirtung. The largest icecap, the Penny Icecap, lies to the west of Pangnirtung Pass.

I am grateful to P. D. Baird for asking me to join his expedition, to the Arctic Institute's Carnegie Program for their generous financial grant, and to several members of the expedition for their notes on mammals.

NOTES ON SPECIES SEEN

ARCTIC FOX *Alopex lagopus.* Foxes were rare in all areas visited. I saw one in Owl Valley on July 9, and heard calls from this place on several other days. When I saw the fox, it barked loudly, but it seemed inquisitive and unwilling to move away. F. H. Schwarzenbach heard one in Naksakjua Valley later in July, not more than 5 km from where I saw the earlier one. W. H. Ward twice saw tracks at about 1800 m on the Penny Icecap at passes where there were also many lemming tracks. Local people at Padloping, Pangnirtung and Frobisher Bay said they were scarce, and we saw none there. According to the Hudson's Bay Co. manager there they had increased around Pangnirtung by late 1954.

WOLF *Canis lupus.* A fresh track at the top of Owl Valley on June 11 was probably of this species.

ERMINE *Mustela erminea.* Rare in all areas visited. None was seen in Owl Valley or in the valleys and coastal lowlands to the east. There was a very inquisitive one, at the top of Pangnirtung Pass (400 m) in the first week of August. It had completely molted, and had brown upper parts and bright creamy yellow under parts. In late August H. R. Thompson saw one or two in summer coat in the southern part of Pangnirtung Pass. They were also reported rare at Frobisher Bay.

BARREN-GROUND CARIBOU *Rangifer arcticus*. Only one caribou was seen by the expedition: a young male in Owl Valley on June 25. Schwarzenbach also saw a few fresh tracks in Naksakjua Valley on July 25. Eskimos at Padloping told me that a south-facing slope halfway up Padle Fjord was still a favorite caribou place, where they had seen six in late May 1953, and where I saw fresh tracks in early June. In Owl Valley we found many skulls, bones and antlers, mostly very old and covered with lichens. Nearly all the antler points were intact, but a few had been chewed. Well-beaten caribou paths were common, especially on passes through the mountains, such as from Owl Valley to June and Naksakjua valleys. Some of the ruined stone huts at the top of Pangnirtung Pass contained great numbers of caribou bones; probably the Eskimos had used these huts as meat caches and this spot had been a hunting headquarters. This pass is one of the few practicable caribou routes through the Penny Highlands. On the east coast, I saw only one skeleton, a very old one on Durban Island southeast of Padloping. Soper (1928) recorded that many winter in Cumberland Peninsula but move to the western lowlands in summer.

ARCTIC HARE *Lepus arcticus* Seen in all areas visited, but uncommon. Only one was seen on each of three counts over a two-square-mile area of Owl Valley, and on a fourth count none at all. There were more on the outer coast: four on a square mile of heathy island near Durban Island, ten on about 1½ square miles of Cape Searle, and four on one square mile of Padle Fjord. Such counts were easily done in May and early June when the hares were still white, when most vegetation was not high enough to hide them, and when most of the snow had melted.

I collected notes on the color change of 43 hares and others on the expedition gave me notes about a further 13 (see Appendix). To standardize these observations, I used a formula which I had already found suitable for a similar study in Scotland. There were five different categories and category symbols: LL (all white), L (mostly white), LD (half white, half dark), D (mostly dark), and DD (all dark). Animals that were LL also had dark ear tips, and animals that were DD had white fur on abdomen and feet. If a figure is assigned to each category symbol, it is easy to work out the average molting state of a number of individuals during any period (Table 1).

All the following records are from field observations, unless shot specimens are mentioned. Ten hares at Cape Searle at 400 m on May 23 and four at sea level near Padloping on May 31 were all pure white. One shot at sea level on June 1 was white without any brown under fur, and five more looked pure white. Another shot there was white externally, but had light brown patches around the eyes and lips, and also a dense growth of short brownish-gray fur all over the upper parts, underneath the long white winter fur. One on June 1 or 2 in Pangnirtung Pass, and two in Owl Valley on June 11 and 13 were white. In Owl Valley one was white on June 27, and two on June 27 and two on July 2 were largely dark on head and neck; a third of the back was dark. One at 600 m on July 9 was white except for brown patches on head and neck. Two on July 24 were dark except for white patches on the sides and neck, and white

legs, tail, breast and belly. Two in the Pass about July 20 were also half white, and one there at the end of July had only a little white. One in Owl Valley on July 26 was white. A female shot at the Pass summit on August 5 showed no external signs of molt and was light gray-brown all over its back and slate-gray on head and flanks. However the legs, tail, and belly were wholly white and many of the long white winter hairs had not been shed, especially on the flanks and belly. This specimen was already in molt to the winter pelage, with dense winter white hair growing on the flanks and elsewhere. At the Pass summit, two on August 6 were slightly darker, with some dark on the upper part of the fore legs. Another on August 8 was whiter, with large white patches on the flanks, neck and rump. Two more seen in dim light on August 8 looked gray. Four at the Pass summit on August 12 were completely dark blue-gray except for white legs, breast, belly and tail, and two on August 13 were half white. Two on August 23 in Owl Valley had large white patches on the neck and back, and there were gray-brown hairs nearby sticking to the heather. One near the Pass summit on August 25 was dark with some little white patches. One in the south of the Pass at 900 m on August 28 and one on August 29 were white, and one on August 30 still half gray. Two at Pangnirtung on September 4 were white.

To summarize, the color change became noticeable in the field in the second half of June, and the hares were at their darkest for a brief time at the beginning of August. By the second half of August, they were already rapidly changing to the white winter coat, and by early September were completely white again. Summer molt begins before dark patches are visible in the field, and white winter fur is growing underneath in autumn when the animal is still dark. Such details are apparent when specimens are examined. The earliest spring specimen started growing its brown fur in late May, and the earliest in autumn probably started winter molt about late July.

This molting pattern is much the same as in northeast Greenland, where the summer molt occurs from late May to late June, and where winter molt begins in mid-July and nearly all have finished by September (Salomonsen, 1939). However, our Baffin hares in 1953 grew a more complete summer coat than in Salomonsen's specimens from northeast Greenland, which at the most changed color only partly on the head and had some scattered dark hairs along the center of the back. We saw no hare in a completed summer coat with dark fur on lower legs and breast. Even well-molted ones usually had largely white legs and belly and some white patches on the upper parts, and many unshed white hairs from the long winter coat could often be seen in the field, sticking far above the short summer fur. Kumlien (1879) also noticed that there was no more than a partial color change in Cumberland Sound hares.

Kumlien believed that many hares in this area stayed white throughout the year, though he gave no proof of this. Adult hares in Devon Island are said to remain white throughout the year (Soper, 1928); and on Prince Patrick Island, Macdonald (1954) noted a color change in some but wrote that some seem to remain white in summer. Like us, Kumlien and Macdonald saw white hares in every summer month, but this does not prove that some hares stay white the whole summer. We saw white hares as late as June 27 and as early as

TABLE 1
FIELD NOTES ON COLOR CHANGE OF HARES, CUMBERLAND PENINSULA, 1957

Period	Number of hares in each category					Mean category[1]
	All dark (DD)	Mostly dark (D)	Half white (LD)	Mostly white (L)	All white (LL)	
May 16-31					14	4.0
June 1-15					10	4.0
June 16-30				2	1	3.3
July 1-15				3		3.0
July 16-31		1	4		1	2.2
August 1-15		9	3			1.3
August 16-31		1	3		2	2.5
September 1-15					2	4.0

[1]The mean is calculated by assigning the following figures to each category symbol: 0 for DD, 1 for D, 2 for LD, 3 for L and 4 for LL.

July 26, so there might be only one month between those late in turning dark and those early in turning white. In Baffin Island on September 3 Manning (1943) saw a hare that was white except for dark fur on the head, and which had a white body coat that he thought might have been worn all summer. However, even this animal had partly changed color, and a Greenland specimen similar to it was described by Salomonsen. So far, there is no record of any pure-white hares having been seen in the field, far less white specimens without a trace of dark fur underneath, in this part of Baffin Island in early and mid-July, which is probably the crucial time for a clear answer to this problem.

SUMMARY

1. Notes on mammals are recorded from the mountainous area of Cumberland Peninsula, Baffin Island.

2. Foxes, ermine and caribou were rare. Arctic hares were uncommon, varying from one hare per two square miles to four or more per square mile.

3. The hare's color change was studied by standardized field observations. Summer molt started in late May and winter molt in late July. The color change was noticed in the field in late June; the hares were darkest in early August, and were white again by September. White hares were seen in every month, but there is no proof that some stay white all summer.

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LATE BREEDING IN NEWFOUNDLAND SNOWSHOE HARE

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SEVERAL authors have recorded snowshoe hare pregnancies as late as September. Criddle (1938) stated that pregnancy may occur as late as October. Grange (1932), Aldous (1937), MacLulich (1937), and Severaid (1942), all found August to be the terminal month of pregnancy. Adams (1959) believes pregnancies terminate in Montana about August 1.

Embryos from 52 gravid female hares collected in Newfoundland between 1956 and 1959 were aged from known age collections provided by Joseph Dell of the New York State Conservation Department. From these data and a study of the male reproductive cycle it was determined that the normal breeding season for Newfoundland hares extends from late March to early August (Doods, 1960).

Siegler (1954) reported a New Hampshire hare collected on November 28 carrying two fetuses, each measuring about 115 mm. Fetuses this size would normally be close to term so that the breeding date was probably about October 23.

Through the co-operation of the Newfoundland Department of Mines and Resources nine records of abnormally late breeding in Newfoundland hares have been obtained by the author since 1950. Fetuses were collected and aged in seven of these instances. The ages of the gravid hares were undetermined. Five of the nine records were from western Newfoundland, three from the central portion, and one from the Avalon Peninsula in the eastern section of the province. Table 1 provides collection dates, numbers and ages of fetuses, approximate breeding dates and collection areas.

TABLE 1. ABNORMAL BREEDING RECORDS IN NEWFOUNDLAND SNOWSHOE HARES

Date collected	Number of fetuses	Approximate age of fetuses in days	Approximate breeding date	Collection area
November 29, 1953	4	29	October 31-November 1	South Brook-Humber District
November 22, 1954	4	36	October 17-18	St. Georges-St. Georges District
November 22, 1954	4	34	October 19-20	St. Georges-St. Georges District
November 30, 1955	2	36	October 25-26	Calvert-Ferryland District
January 1-10, 1959	3	36	November 26-December 6	Lewisport-Gander District
November 11, 1960	1	36	October 5-6	Badger-Grand Falls District
January 22, 1961	2	34	December 18-19	Millertown-Grand Falls District
(Reported) December 3, 1950	–	–	–	Cormack-Humber District
(Reported) November 29, 1953	–	–	–	Cormack-Humber District

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CORRECTION NOTE

In Vol. 75, No. 4, of this journal, on p. 174, line 2, for 50° read 53°; on p. 183, left column, after STAR-NOSED MOLE delete the third *cristata*.

NOTES ON NORTH ATLANTIC WHALES

Bruce S. Wright
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I served as a watch-keeping officer in the Royal Canadian Navy in the Gulf of St. Lawrence, Newfoundland and Iceland waters, and the trans-Atlantic convoy routes during 1941 and 1942. My duties as the Anti-Submarine Control Officer of the ship included the classification of all sounds and echoes picked up on the asdic as "sub" or "non-sub." Therefore I was always called when whales were in the vicinity. These observations giving dates and positions may be of value to cetologists.

The assistance of Raymond M. Gilmore, who, when biologist of the Office of Foreign Activities of the U.S. Fish and Wildlife Service made a preliminary inspection of these notes, is gratefully acknowledged.

Spring and Summer Observations

April 3, 1942. 44°N 60°W (North of Sable Island). A small pod of fin whales *Balaenoptera physalus* was observed at close range while they were mating. Several white-sided dolphins *Lagenorhynchus acutus*, or possibly white-beaked dolphins *L. albirostris* Gray were observed at a distance.

May 16, 1942. 55°N 14°W. One adult male and two smaller killer whales *Grampus orca* L. were observed at close range. One of the small ones jumped clear in the wake.

May 17, 1942. 54°N 20°W. Two killer whales were seen.

May 19-21, 1942. Vicinity of 45°N 37°W. At least six fin whales were observed.

May 22, 1942. 47°N 39°W. An unidentified large whale was seen blowing.

June 2, 1942. 45°N 45°W. Thirty-forty unidentified dolphins or porpoises were seen in one herd. The largest was 10 feet, average 6 feet; color was solid dark at a quarter of a mile. They jumped continuously.

June 4, 1942. 50°N 45°W. At 3.35 a.m. the asdic operator reported torpedoes approaching. It was a herd of dolphins or porpoises traveling fast in an extremely compact group and leaping high out of the water. The loud whistling noise they made in the earphones was almost deafening, and as it was quite unlike anything the operator had heard before, he identified it as torpedoes.

June 6, 1942. 55°N 31°W. A group of five killer whales was depth charged with a five-charge pattern, which exploded within a hundred yards. They rose to blow, apparently unperturbed and moving leisurely and not the least alarmed. There were two large and three smaller ones in the herd. One large male came over to inspect the ship. It came to within 10 yards before sheering off. The dorsal fin of this whale was at least four feet high. When last seen, the whales were still traveling slowly on the surface in a compact group.

June 21, 1942. 56°N 15°W. A curious patch in the sea was observed at close range. It was red and 40 to 50 feet across, and rose from the depths in a column. This may have been a swarming of *Meganyctiphanes norvegica* (M. Sars), or *Rhoda inermis* (Kröyer), euphausid crustacean zooplankters which rise to the surface in this manner and then spread out. They are an important food of the baleen whales. There was no opportunity to take a sample.

June 25, 1942. 56°N 28°W. A small pod of fin whales was seen at a distance.

June 26, 1942. 45°N 57°W. A large school of dolphins or porpoises was observed but it was too far off to identify. They were accompanied by several young 3 or 4 feet long. They were not jumping but traveling on the surface.

July 12, 1938. The St. Lawrence River, 8 miles above Quebec City. A large specimen of the *Delphinidae* jumped clear of the water opposite the Chaudière Bridge. It was at least 10 feet long and of a uniform dark color all over. It was a mile away.

July 14, 1942. Gulf of St. Lawrence, off Gaspé coast. A very large whale, considerably larger than the fin whales frequently seen here, passed the ship. It was assumed to be a blue whale *Balaenoptera musculus*.

July 21-Aug. 2, 1942. Gulf of St. Lawrence. Many fin whales were seen off Cape Gaspé and in the Gulf.

July-September, 1942. A humpback whale *Megaptera novaeangliae* (Borowski, 1781) was often seen off Cape Gaspé. It was always alone and was never seen far from the mouth of Gaspé harbor.

July 22, 1942. Gulf of St. Lawrence. The common porpoise *Phocoena phocoena* (L.), was seen frequently on this date. The pilot whale *Globicephala melaena* (Traill) was also seen in small numbers.

Aug. 3, 1942. Bic Island, Lower St. Lawrence. A lone bull killer whale was observed at close range. It was very large.

Aug. 4-Sept. 1, 1942. Gulf of St. Lawrence. Fin and pilot whales were seen almost every day during this period.

Aug. 26, 1944. Two hundred miles west of Ireland in 55°N. I found a large, dead whale covered with gulls. Discovery was made from an aircraft and it could not be further identified. This was apparently a case of natural mortality as no whaling was carried on in those waters in wartime.

Aug. 30, 1941. Gulf of St. Lawrence, off Gaspé coast. Three fin whales were traveling together up river.

Sept. 1, 1941. Nova Scotia coast, between Cabot Strait and Halifax. Many common porpoises played around the ship.

Fall and Winter Observations

October 31, 1941. South of Cape Race, Newfoundland. Two large unidentified whales were blowing.

December 5, 1941. At the mouth of Hvalfjordur, on the west coast of Iceland. A raft of ducks and geese was feeding at the mouth of the fiord. They

periodically opened out leaving a circular open space in the middle of the raft, and a few seconds later a small whale blew in this opening. There were several whales and they were apparently feeding on the same shoal of small creatures that attracted the ducks and geese. The whales appeared to be 10 to 15 feet long, light in color, and with no visible dorsal fin. They were, at the time, considered to be narwhales *Monodon monoceros*, because of size, color, and lack of dorsal fin, although no tusks were seen. However, Saemundsson (1939) has only four records of this species from Iceland in the past century. These records were on this coast, but in spring migration, so this identification must be considered doubtful.

December 13, 1941. 46°N 48°W. A herd of about 15 white-sided dolphins played about the ship.

February 28, 1942. Grand Banks of Newfoundland. A pod of six small sperm whales *Physeter catoden* crossed the bow and one was cut in two. They were swimming in pairs and traveling north. They were probably young males, as the Newfoundland whaling station very rarely takes a female in these waters.

March 3, 1942. 42°20'N 52°50'W. Grand Banks of Newfoundland. Three fin whales in Whale Deep.

The only other whale seen was the white whale *Delphinapterus leucas* (Pallas). It was seen on August 31, 1942, in the lower St. Lawrence River, and on October 16, 1938, off the Island of Orleans below Quebec. Both these records agree with the autumn distribution of the species as given by Valdykov (1944).

Noises heard on the asdic from dolphins or porpoises were of two distinct types. The first was a squealing, squeaking noise from a herd, particularly when they were very active and jumping. The second type was made by a straggler from a large herd which was obviously trying to catch up. This noise resembled the grinding of teeth and was very loud.

A third type was heard from a fin whale. This individual separated from a small pod and approached cautiously to within 20 yards of the ship as if trying to identify it. It appeared to see the ship for the first time at this distance. It fled sounding an alarm call that alerted the others, and they all rushed off at full speed. The alarm call lasted for 30 seconds and then ceased abruptly. It sounded like "tock! . . . tock! . . . tock!" at the rate of one every three seconds. The asdic operator commented that it sounded like the echo-sounder running fast. The whole pod altered 90° from the ship's course and disappeared in the distance still on the surface.

SUMMARY

Dates and positions of twenty-six observations on Cetacea in North Atlantic, Iceland, and eastern Canadian waters are recorded. Observations of ten species in spring and summer and also fall and winter are given, and a doubtful record of narwhales in Iceland is discussed. The date and position of a possible swarming of crustacean zooplankters is given.

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REPORT OF COUNCIL THE EIGHTY-THIRD ANNUAL MEETING OF THE OTTAWA FIELD-NATURALISTS' CLUB

December 5, 1961

There were five Council meetings at the National Museum of Canada during the past year: December 15, 1960, February 14, 1961, April 20, September 14, and November 8, with an average attendance of 17 council members.

Unfortunately the President, Mr. W. W. Mair was forced to relinquish his duties because of an out-of-town posting and Dr. Solman resigned as Second Vice-President because of increased work load. However, the remainder of the Club's executive rallied to carry on the Club's business.

The Club was saddened to learn of the passing of two long-time members, Dr. R. M. Anderson (former President, 1920-22) and Mr. H. A. C. Jackson.

Appointments for 1961 offices were made as follows:

Editor, CANADIAN FIELD-NATURALIST – R. A. Hamilton
Business Manager, CANADIAN FIELD-NATURALIST – W. J. Cody
Chairman, Publications Committee – W. J. Groves
Chairman, Excursions and Lectures Committee – D. R. Beckett
Chairman, Reserve Fund Committee – H. Lloyd
Chairman, Bird Census Committee – V. E. F. Solman
Chairman, Membership Committee – R. J. Moore
Chairman, Macoun Field Club Committee – H. J. Scoggan
Chairman, F.O.N. Affairs Committee – D. A. Smith
Chairman, Public Relations Committee – E. L. Bousfield
Chairman, Preservation Historic Sites Committee – W. K. W. Baldwin

REPORT OF THE PUBLICATIONS COMMITTEE

During 1961 four numbers of Volume 75 of the CANADIAN FIELD-NATURALIST have been published comprising a total of 268 pages plus index. Papers, notes and reviews were distributed as follows:

Botany	6	2	4
Entomology	4		1
Geology			1
Herpetology	1	4	
Ichthyology		1	1
Malacology		1	2
Mammalogy	6	6	1
Marine Biology			2
Ornithology	7	15	9
Miscellaneous	2		11
	26	29	32

The committee has approved accounts totalling $3,404.17 for Vol. 74, No. 4, and Vol. 75, Nos. 1-3. This amount includes $368.47 for reprints which will be recovered from the authors. Contributions totalling $55 have been received from affiliated societies. Sales of back numbers in 1961 totalled $149.53.

The supply of back numbers has been moved to new and better storage quarters in the K. W. Neatby Building.

On the death of Mr. H. A. C. Jackson in July 1961, his family requested that donations be made to the Ottawa Field-Naturalists' Club in lieu of floral tributes and that this money might be used for the publication of some form of memorial article. The fund now totals $337.

The publication of the CANADIAN FIELD-NATURALIST was materially assisted this year by a grant of $500 from the Conservation Council of Ontario. The size of the journal was increased in 1961 over 1960 by approximately eighty pages. This assistance is gratefully acknowledged.

REPORT OF THE EXCURSIONS AND LECTURES COMMITTEE

During the past year, the Excursions and Lectures Committee have conducted four indoor workshop evenings, two spring field trips and one fall field trip, four morning bird walks and the annual dinner. A total of eight Committee Meetings were also held.

Although our attendance has not been large, it has been fairly steady averaging about 50 at the indoor meetings and 25 on our excursions.

The Annual Dinner held at the Experimental Farm was attended by approximately 110 persons. The speaker, Dr. J. D. Ives of the Geographical Branch, gave an illustrated lecture on the deglaciation of Labrador-Ungava.

One copy of the Newsletter was published during the year.

REPORT OF THE RESERVE FUND COMMITTEE

Thirty-five rights to purchase Bell Telephone stock and five shares of Bell Telephone were bought, increasing our holdings in this company to twenty shares.

REPORT OF THE MEMBERSHIP COMMITTEE

No meetings were held during the year.

At the suggestion of Council, a letter of welcome to new members was prepared and mimeographed. This has been sent to new members immediately upon receipt of their application and fee.

The Chairman has presented to Council applications for the following new members: active members: 5 local, 12 non-local, 5 institutions; associate members: 5.

The circulation of the CANADIAN FIELD-NATURALIST stands at 738, a net decrease of 54 over the comparable 1960 figure. The decrease is due to a more rigorous deletion of unpaid members and does not indicate an unusually high drop in memberships.

REPORT OF THE BIRD CENSUS COMMITTEE

Our forty-second Christmas Bird Census was held on December 31, 1960. Thirty-eight observers reported a record total of 46 species, surpassing the 1959 record by one. Five new species were added to the all-time list, bringing it to a total of 87 species. The details were published in the *Audubon Field Notes*, Vol. 15, No. 2.

REPORT OF THE MACOUN FIELD CLUB COMMITTEE

The usual weekly meetings were held in the spring, with Cedric Pearson, Mark Blackburn, and Gary Kaiser presidents of the Junior, Intermediate, and Senior groups, respectively. Eleven of the meetings featured guest speakers. Some short field trips were made in the Museum area. The thirteenth birthday party was held in May, at which badges were presented to qualifying new members, No. 19 of the Club's magazine, *The Little Bear*, was distributed, and a programme of nature films was shown, followed by a visit to the Club's exhibits in its headquarters.

The Club's room at the National Museum has been taken over for other functions and we welcome the coming move to a more attractive and spacious location on the third floor.

REPORT OF F.O.N. AFFAIRS COMMITTEE

The committee continued liaison with the Federation of Ontario Naturalists' headquarters at Toronto. The routine business included: distribution of brochures and announcements of the F.O.N. sponsored camp, recordings and *The Young Naturalist;* sale of 27 dozen F.O.N. Christmas cards and hastinotes, on which the Club will profit by $6.75; and advice on nature education to local young people referred to us by the F.O.N.

REPORT OF THE HISTORIC SITES COMMITTEE

The committee considered two sites but was inactive for most of the year.

REPORT OF THE PUBLIC RELATIONS COMMITTEE

During 1961, the newly formed Public Relations Committee assumed responsibility for coverage of Club activities by the local press, radio, and television wherever deemed necessary or desirable by committees concerned with these activities.

A. W. F. BANFIELD, *Secretary*

STATEMENT OF FINANCIAL STANDING
THE OTTAWA FIELD-NATURALISTS' CLUB, November 30, 1961

CURRENT ACCOUNT

ASSETS		LIABILITIES	
Balance in bank, Nov. 30, 1961	$2,929.62	Cheques outstanding	$ 125.00
Bills receivable, separates	175.87	Balance	2,980.49
	3,105.49		3,105.49
RECEIPTS		**EXPENDITURES**	
Balance in bank, Nov. 29, 1960	1,329.68	Can. Field Nat. 4 numbers	2,710.81
Fees:		Separates & Illustrations	650.89
Current $2,566.30		Editor's honorarium	100.00
Advance 309.15		Business Managers honorarium	15.00
Arrears 203.35		Newsletter	7.05
Associate 69.15	3,147.95	Excursions & Lectures Committee	49.71
Separates & illustrations	1,131.61	Postage & Stationery	226.43
Sale of back numbers	149.53	Bank Discount	31.11
Donations:		Foreign Exchange	15.01
Conservation Council, Ontario 500.00		Miscellaneous	58.91
H.A.C. Jackson Gifts 337.00		Bank Balance Nov. 30, 1961 2,929.62 less 125.00 o/s cheques	2,804.62
Affiliate Societies 55.00	892.00		
Miscellaneous	18.77		
	$6,669.54		$6,669.54

RESERVE FUND

ASSETS		LIABILITIES	
$3,000 Ontario Hydro 3% Bonds market value	2,700.00		
20 shares Bell Telephone stock, market value	1,160.00	NIL	
Balance in Bank Nov. 30, 1961	125.94		
	3,985.94		
RECEIPTS		**EXPENDITURES**	
Balance in Bank Nov. 29, 1960	229.86	Safety Deposit Box	5.00
Bank Interest	1.73	Purchase Bell Stock	190.00
Bond Interest	90.00	Purchase of Rights	39.00
Dividends Bell Telephone	38.50	Bank S.C.	.15
		Balance in Bank, Nov. 30, 1961	125.94
	360.09		360.09

PUBLICATIONS FUND

ASSETS		LIABILITIES	
$1,500 Ontario Hydro 3% Bonds market value	1,338.75	NIL	
Balance in Bank Nov. 30, 1961	190.58		
	1,529.23		
RECEIPTS		**EXPENDITURES**	
Balance in Bank Nov. 29, 1960	141.75		
Bank Interest	3.73	Balance in Bank, Nov. 30, 1961	190.48
Bond Interest	45.00		
	190.48		190.48

Audited and found correct, November 30, 1961

(Signed) I. L. Conners
C. Frankton, Auditors

(Signed) J. M. Gillett, Treasurer

REVIEWS

The Garden Flowers of China
By H. L. Li. New York, Ronald Press, 1959. 240 p. $7.00 (Chronica Botanica No. 19)

Few writers can skillfully combine art, floristics, history, legend, geography – humanity, indeed. But in *The Garden Flowers of China* Hui-lin Li has done just this.

The first chapter sets the scene, and does it admirably. When we read that "there are more kinds of . . . plants growing in China than there are in all other countries in the whole Northern Hemisphere combined," we know that a rich reward awaits us as we continue through this book. When we learn that such garden delights as peony, tiger lily, camellia and daphne assumed importance in the Sung Dynasty, about A.D. 1100, we are not surprised to learn that this age also saw the flowering of art and literature. The Chinese are always close to the good earth. For them, art is something to be lived, not acquired. And their love of flowers is only surpassed by a love for the people who grow them.

Fact and fancy pour from every page. Knowledge that the facts come from a professor of botany at the University of Pennsylvania is enough to assure us of their veracity. The fancy gives the book an intriguing charm. We discover that a wine is made of chrysanthemums, and the lotus is idealistic because it "emerges from muddy dirt but is not contaminated"; we learn the fascinating story of the Chinese sacred lily (*Narcissus tazetta*) and the even more absorbing account of the mysterious jade flower.

It is hardly to be expected that so comprehensive a book should be without a flaw. The demerits are regrettable because they seem to be due to hastiness, which is certainly not a Chinese trait. The general reader will wish that some simple convention of type face had been used to distinguish personal names from other Chinese names, and will regret the lack of consistency in manner of writing and capitalizing multiple names of plants. (Shao-yao, which is better hyphened, varies in the same chapter.) Specialists in Chinese will find, I'm afraid, a good many errors, orthographic and otherwise. (On page 14 the second element of a well-known book title incorrectly reads *Ssu* and, following this, *Eulogies* appears for *Elegies;* on page 53 a plant name is written P'in Tsû Mei, but the error in the second word is corrected in the index; most of the more complex ideographs, though recognizable, are indistinct, and in at least one instance, at the bottom of page 230, the character for La is incorrect.) Botanists will probably be just temporarily confused by discrepancies. (On page 46 the Chinese aster is said to be *Callistephus chinensis* but in the reference on page 47 it is called *Callistephus hortensis;* on page 151 the reference to Shirai is haplessly placed after *Catalpa ovata* instead of after *C. bungei.*) Such lapses as the above, however, can, and I hope, will, be corrected in future editions.

The particular importance of the book to this country lies not only in its addition to our knowledge of a Pacific neighbor. It must suggest a serious desideratum in Canada. In 1919 Berthold Laufer wrote that "the Chinese furnish us with an immensely useful material for elaborating a history of cultivated plants." Furthermore, as a part of the last chapter of Mr. Li's book implies, collectors are still introducing Chinese plants to the Western world. From a rough check of the trees and shrubs in the Dominion Arboretum, I believe that about a third of the natural species in this collection come from China. And yet, to the best of my knowledge there is in Canada no botanist working in the prodigiously fertile field of Chinese plants.

In format this book is satisfying. The brush type on the cover and spine is appealing and harmonious. Line drawings from Chinese books are interesting

and decorative, especially with their identifying matter in wood block, seal characters or running hand. The half-tones, exceedingly well done and well displayed, are, in fact, a distinct feature of the book. The author's direct but flowing prose style might well be emulated even by writers whose mother tongue is English. Because of its lively presentation of the main subject the book deserves a place in every library of the literature of plants. More than this, *Garden Flowers of China* may well serve to introduce to some readers the tremendous riches of the literature of China.

ROBERT A. HAMILTON
Manotick, Ontario

Mr. Hamilton, former editor of this journal, is a nurseryman and a member of the American Oriental Society.

A Flora of the Alaskan Arctic Slope
By IRA L. WIGGINS AND JOHN HUNTER THOMAS. Arctic Institute of North America Special Publication No. 4 University of Toronto Press, 1962. vii 425 p. $9.50.

In recent years we have seen a notable upswing in arctic-alpine biological study. Largely because of the establishment of the Arctic Research Laboratory at Barrow in 1946, by the United States Office of Naval Research, northern Alaska has had an important part in such studies. This volume, by two of the Stanford botanists who worked at Barrow, is a most valuable contribution to the biology of the region. It will be especially useful to biologists working in northern Alaska and to students of plant geography.

An introductory chapter discusses geographic limits, edaphic factors, climatological factors, permafrost, biological factors and habitats. The main body of the book contains full keys, detailed descriptions, habitat data, general range, citations, and a numerical summary. Four appendices (gazetteer, distribution maps, glossary, and references) and an index complete the book. The citations include all specimens not seen by Hultén except for the commonest species at a few localities. The maps, each with two to four species, are large enough to allow quite accurate plotting. The gazetteer, facing a key map, is a highly commendable feature. For most species coverage seems to be adequate except for the extreme eastern and the southeastern areas, for which there are almost no records.

The taxonomy is conservative, no new taxa being recognized and no transfers being made. Two minor omissions may be a hindrance to some users, especially those without ready access to a taxonomic library. Virtually no synonymy is given; and the specific authority is omitted when the nominate subspecies or variety is absent from the region.

This compilation throws considerable light on the climatic range of the arctic slope. The numerical summary reveals a total of 466 species and lower taxa, which is impressive in view of the whole region being north of the 68th parallel. It is surprising to see Compositae as the largest family in species and second largest in genera, until one realizes the extraordinary range in summer climate encountered as one passes some 200 miles south from Barrow. Barrow, exposed to the Beaufort and Chukchi Seas, has a cold summer with a July mean of 40°F, about that of Resolute. As one studies the distribution maps one is impressed by the concentration of high-arctic species at Barrow and along the coast. The more southerly species that we associate with montane and subalpine situations do not reach the coast but are confined to the foothills and mountains. No adequate weather data are available for any station except Barrow, but summer temperatures at Umiat, only 80 miles from the coast, are said occasionally to approach 90°F. With willow, alder and balsam poplar attaining heights of 20 to 30 feet in sheltered sites, the foothills region is scarcely arctic in climate, although spruce, the frequently accepted marker for limits of the Canadian arctic, is absent.

D. B. O. SAVILE

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MAMMALS OF THE DELTA MARSH REGION OF LAKE MANITOBA, CANADA

James R. Tamsitt
University of the Andes, Bogotá, Colombia

The field work from which this report is drawn was conducted from June 6 through August 12, 1958. The base of operations was the Delta Waterfowl Research Station at Delta, Manitoba. Most of the collections and observations were made in the vicinity of Delta and in areas to the south of the Delta Marsh. Mammal records were obtained by live trapping, by steel traps, by tumble-in traps, from information supplied by local residents and station personnel, from sight records and from the literature. Seventy-two specimens of 19 species of mammals were collected in the area, and sight records of seven other species were made. In addition, five specimens of four species collected near Winnipeg in September 1957 and 20 specimens of 12 species in the Delta Waterfowl Research Station Collection (DWRSC) are reported.

The study was supported by a grant from The University of Manitoba. H. A. Hochbaum, Director, Delta Waterfowl Research Station, made available the station's facilities. I am indebted to Roland LaFleche, Richard Phillips, Kitson Vincent, George Hochbaum and Peter Hochbaum for information and for aid in collecting; to Jennifer Walker for identifying the plants collected by the author; to Peter Ward for suggesting trapping localities and for supplying pertinent information concerning the distribution and abundance of the mammals in past years; and to the various residents of the Delta Region who allowed me to trap on their land. I am indebted to R. L. Peterson for reading the manuscript.

Ecology

The Delta Marsh, about 50 miles northwest of Winnipeg, is a flat expanse of 36,000 acres and one of the largest remaining marshes in the Canadian wheat prairies. The area is part of the lakebed of glacial Lake Agassiz, where over long periods of time water has deposited thick layers of lacustrine sediments. Further modification of the soils of the marsh by the addition of large quantities of plant material from decaying vegetation has resulted in black, rich soils high in organic content (Ellis, 1938).

In his discussion of the major vegetational regions of Manitoba, Scoggan (1957) places the Delta Region in the Aspen Parkland, a region of transition between the true prairie and the coniferous forest and characterized by forest extending far into the prairie along the rivers and by groves of trees inter-

Mailing date of this number: August 29, 1962

spersed by prairie. This region is assigned to Thornthwaite's (1931) CC'd climatic province, that is, it is subhumid, microthermal, and moisture-deficient at all seasons. The mean annual temperature at Portage la Prairie, 16 miles south of Delta, is 35° F. Summer temperatures above 100° F and winter temperatures of -30° F are not uncommon (Thomas, 1953).

The study area lies at the southern end of Lake Manitoba. A low wooded sand ridge averaging 100 yards in width separates the marsh from the lake. Because of the ridge, there are few water connections between the lake and the marsh to the south of it. The marsh, an area of large open bays and smaller isolated sloughs and potholes between the bays and the lake, is fed by surface runoff alone. The bays and sloughs are bordered by bulrush (*Scirpus acutus*) and cattail (*Typha latifolia*), but the predominant marsh plant is phragmites (*Phragmites communis*), which forms large expanses in shallow water. Broken by occasional meadows, hayfields and pastures, the phragmites extend from the marsh waters to the ridge on the north and to the prairie wheat fields on the south.

Three general habitats were trapped. At localities east and west of Delta, traps were set along the beach ridge in woody associations in which willows (*Salix niger, S. amygdaloides, S. lucida* and *S. interior*), green ash (*Fraxinus pennyslvanica*), burr oak (*Quercus macrocarpa*), cottonwood (*Populus deltoides*) and elm (*Ulmus americana*) formed dense overstory. Understory was composed of such woody plants as saskatoon (*Amelanchier alnifolia*), elderberry (*Sambucus pubens*), American hazelnut (*Corylus americana*), poison ivy (*Rhus radicans*) and choke cherry (*Prunus virginiana*) and several species of grass (*Agropyron repens, A. trachycaulum, Agrostis stolonifera* and *Poa pratensis*). In several localities the woody areas of the ridge were interrupted by grass meadows on sandy soil, and *Agropyron trachycaulum* was the common grass in such situations.

In grassy areas adjacent to the marsh and in places that had been marsh in the past but because of low water levels had been drained and invaded by secondary vegetation of grass, *Microtus* and *Blarina* were taken. In these situations the principal grasses included *Hordeum jubatum, Puccinellia nuttalliana, Scholochloa festucacea* and *Spartina pectinata.*

Fringing the marsh and irregularly distributed in the prairie between Delta and Portage la Prairie were many groves, locally known as bluffs. These islands of woody vegetation were ecologically distinct from the surrounding prairie, and in such places smaller rodents such as *Peromyscus, Clethrionomys* and *Zapus* were common. The plant constituents of the groves varied considerably, and although some groves of pure aspen fringed the marsh on the southeast, trapping was conducted in groves in which the dominant trees were pure stands of burr oak or mixtures of oak and Manitoba maple (*Acer negundo*). Such woody plants as wild black current (*Ribes americanum*), choke cherry, elderberry and wolfberry (*Symphoricarpus occidentalis*) were found beneath the tall dominants, and various species of grasses and composites comprised the ground cover. Surrounding the groves were either prairie or fields. In fallow field melilot (*Melilotus officinales*) was the common plant.

ACCOUNTS OF SPECIES

The list includes all the species of mammals that are known to occur or to have occurred recently in the Delta Marsh Region. Species which may exist in the region but for which no definite information is available have not been included. The phylogenetic order and scientific names are those of Miller and Kellogg (1955), and specimens collected are preserved in the Delta Waterfowl Research Station Collection and in the Royal Ontario Museum.

MASKED SHREW *Sorex cinereus* (Say). Tumble-in traps yielded three specimens of this species. On June 27, an adult female was taken from tall grass one mile east of Delta; and on August 6 and 7, two adult females were trapped from tall wet grass bordering the marsh at Delta. Sanderson (1950) obtained a specimen from a grove of choke cherry, burr oak and dogwood three miles south of Delta. Two adult females from Delta are in the Delta Waterfowl Research Station Collection.

ARCTIC SHREW *Sorex articus* Kerr. Two specimens of this species, which occurs in the Canadian Zone of the eastern Manitoba and ranges locally westward in the Transition Zone to Delta, were recorded from Delta by Soper (1946).

WATER SHREW *Sorex palustris* Richardson. In Manitoba this shrew ranges as far west as Aweme (Criddle, 1929) and Robinson Portage (Jackson, 1928), but is considered rare in localities which it has been taken. No specimens were collected in 1958, but Soper obtained a young adult male from the shore of the Delta Research Station pond (DWRSC).

SHORT-TAILED SHREW *Blarina brevicauda* (Say). Although not abundant in any of the localities in which it was taken, individuals were more readily taken from tumble-in traps than from live traps set in moist situations. On June 27, an adult female was obtained from a tall stand of *Spartina* one mile east of Delta; and on July 13, two adult females were trapped from the grassy periphery of an aspen grove three miles southwest of Clarkleigh on the southeast shore of Lake Manitoba. Anderson (1946) listed five specimens from Delta, and two specimens, an adult male and a young adult female, are in the Delta Waterfowl Research Station Collection.

LITTLE BROWN BAT *Myotis lucifugus* (LeConte). Five adult females and an adult male were collected from the attic of a farm house four miles south of Delta in the afternoon of August 6. These were only a small sample of the total colony, which must have been 50 or more in number. This species was the common bat in the Delta region, and although often heard at night, only an occasional solitary individual was seen. Seton (1909) recorded a specimen from Poplar Point, 17 miles southwest of Delta; this bat is probably widely distributed but as yet unreported from other areas in southern Manitoba.

SILVER-HAIRED BAT *Lasionycteris noctivagans* (LeConte). Two specimens of this species are known from Delta (DWRSC). Although these specimens lack collecting data, H. A. Hochbaum informed me that they had been taken several summers ago from behind shutters in one of the local cottages.

WHITE-TAILED JACK RABBIT *Lepus townsendii* Bachman. Sight records and signs of this jack rabbit were noted especially in the dense growths of *Spartina* found in the transition zone between the marsh and dry land south of Delta. An adult female that measured 578 mm was collected in such a habitat three miles southeast of Delta. Specimens from Delta were mentioned by Soper (1946), but in 1958 no individuals were seen in the vicinity of the hamlet or on the beach ridge.

SNOWSHOE HARE *Lepus americanus* Erxleben. Widely distributed in varying numbers over all southernmost Manitoba, this hare was relatively common in heavily wooded vegetation on the beach ridges east of Delta. A specimen was shot July 11 in dense woods on the beach ridge half a mile east of Delta.

WOODCHUCK *Marmota monax* (Linnaeus). This animal was observed by Peter Ward on the beach road four miles east of Delta on June 23 and by George Hochbaum in the hamlet of Delta on the same date. The flooding of the Delta area in 1955 had a deleterious effect on populations of woodchucks established on the beach ridge, and these individuals were the first seen in the vicinity in two years.

RICHARDSON'S GROUND SQUIRREL *Citellus richardsonii* (Sabine). Strictly a prairie animal, this species was characterized by large local populations in short grass of fallow fields south of the Delta marsh. This squirrel and the thirteen-lined ground (*Citellus tridecemlineatus*) occurred together in transition areas at the edge of open prairie.

Sanderson (1949) found this species to be common on the beach ridges of Lake Manitoba in 1945, but only *C. franklinii* was seen on the ridges in 1958. The flood of 1955 completely eliminated squirrel populations in this area, and only *C. franklinii* has subsequently re-invaded the habitat.

Record stations of occurrence are: 9 miles southeast of Delta, 1; 5 miles north of Portage la Prairie, 2; 1.6 miles northwest of St. Laurent, 1. Two additional specimens collected near Delta in 1940 are in the Delta Waterfowl Research Station Collection.

THIRTEEN-LINED GROUND SQUIRREL *Citellus tridecemlineatus* (Mitchill). The smallest of the Manitoba ground squirrels, this species was frequently seen in brush or timbered areas at the edge of open prairie. In July 1958 four specimens were shot in short grass situations at the following localities: 5.6 miles north of Portage la Prairie, 1; 2.5 miles south of Delta, 1; 6 miles south-southeast of Delta, 2. An additional specimen, an adult albino female, was obtained September 10, 1957, near the hamlet of St. Norbert, 6 miles south of Winnipeg.

FRANKLIN'S GROUND SQUIRREL *Citellus franklinii* (Sabine). This species was the only squirrel inhabiting the wooded lake ridges and stream and marshland borders south of Lake Manitoba. When trapping started in early June only a few adult animals were present. However, by late July juvenile and young adult animals were seen in large numbers. Three specimens were obtained in June and July from the following localities: 1.5 miles west of Delta; 3 miles east of Delta; 7 miles east of Delta.

Sowls (1948) studied *Citellus franklinii* periodically from 1938 through 1946 and presented considerable evidence to indicate that Franklin's ground squirrel is a serious predator on duck eggs. In 1958 this squirrel and the striped skunk (*Mephitis mephitis*) accounted for most of the damage to nests of ducks in the Delta Marsh.

GRAY SQUIRREL *Sciurus carolinensis* Gmelin. Although quite rare in the district 15 years ago, populations of this species have reached the size where they are considered to be pests by farmers in the Portage la Prairie – Delta region. Individuals were seen in many oak groves and shelter belts of the area, and an adult female was taken July 9 from an oak grove three miles south of Delta. An additional specimen was obtained by William Carrick from near Westbourne, a small hamlet 10 miles west of Delta.

This squirrel was not found on the beach ridges of Lake Manitoba, and although the dense overstory of woody plants appeared to be a suitable habitat, the marsh that separates the beach ridges from the adjacent farmland apparently acts as a barrier to the dispersal of this species.

NORTHERN POCKET GOPHER *Thomomys talpoides* (Richardson). This was the only gopher in the area, and mounds were commonly seen in dry meadows, fields and clearings in scattered timber where the soil was of a sandy nature. This species was not present on the beach ridges of Lake Manitoba nor in areas immediately adjacent to the Delta Marsh. None were obtained, despite repeated efforts to secure them. Two adult specimens that lack locality data are in the Delta Waterfowl Research Station Collection.

DEER MOUSE *Peromyscus maniculatus* (Wagner). This species was the most abundant rodent of the hardwood forests of the area, and traps set in woody vegetation on the beach ridges and oak groves near the marsh yielded 178 specimens in 440 trap

nights. In 1947 Sanderson (1950) investigated small mammal populations of a prairie grove south of Delta and found *P. maniculatus* abundant in adjoining fields and *Microtus pennsylvanicus* the dominant rodent in the grove. In 1958, however, traps set adjacent to prairie groves yielded *M. pennsylvanicus* and *Clethrionomys gapperi* but no *P. maniculatus*.

Populations of *P. maniculatus* in 1958 were at a peak, and an examination of the catch during June and July showed considerable difference in age composition. In early June twice as many juveniles as adults were taken. Of 26 individuals taken from 40 traps on June 9, 17 were juvenile animals and nine were adults, whereas on July 26 only three of 24 animals captured were adults. The remainder were young adults.

Specimens of the dark eastern subspecies (*P. m. bairdii*) have been recorded from various localities in the province, including the general region of Delta. Soper (1946) has records of typical specimens from Winnipeg, the south shore of Lake Manitoba, Stony Mountain, Mowbray and Aweme. Soper (1946) found that animals west of these localities for a distance of 150 miles showed considerable individual variation, and that in this area intergradation between *P. m. bairdii* and *P. m. osgoodii* is most evident. Specimens from the Delta area were typically dusky, but there was one exception. An adult male taken eight miles east of Delta possessed the pale coloration typical of the race *P. m. osgoodii*. Although this locality is to the east of the supposed intergradation area, if intergradation between the two subspecies is occurring in the Delta region, it is of an extremely limited nature.

Specimens were obtained from the following localities: Winnipeg, 1; half a mile east of Delta, 3; 1 mile east of Delta, 2; 1.5 miles east of Delta, 4; 8 miles east of Delta, 2; 1 mile south of Delta, 5; 3.4 miles south of Delta, 3; 3 miles southeast of Delta, 1; Delta, 1.

GAPPER'S RED-BACKED MOUSE *Clethrionomys gapperi* (Vigors). Specimens were trapped in wooded areas of the beach ridge and in oak groves where the understory was quite dense. Record stations of occurrence are: half a mile east of Delta, 2; 1.5 miles east of Delta, 1; 3.4 miles south of Delta, 2; Delta, 2. Two additional skins from Delta are in the Delta Waterfowl Research Station Collection.

MEADOW VOLE *Microtus pennsylvanicus* (Ord). Although probably one of the common rodents in the area, repeated attempts to trap them alive met with little success. This vole was frequently seen in the daytime in meadows peripheral to the marsh, and runways were most frequently seen in dense stands of *Phragmites communis*, *Hordeum jubatum* and other grasses. An adult female with six embryos averaging 13.6 mm in length was captured in a fallow field 3.4 miles south of Delta on June 11. On July 15, an adult female was taken from dense grass near an old railroad bed one mile south of Delta; and on July 13, two specimens were collected in the grassy periphery of an aspen grove three miles southwest of Clarkleigh on the southeast shore of Lake Manitoba. *Microtus* apparently are not adverse to swimming (Criddle, 1956). On June 23, one was taken from a *Phragmites* mat 300 feet from the shore of Cadam Bay, one mile east of Delta.

MUSKRAT *Ondatra zibethicus* (Linneaus). During the summer of 1958 populations were low, and muskrat houses were seen only at the edge of sloughs and areas of limited water. In previous years fluctuations in the water level of the marsh, heavy trapping by local residents and a severe outbreak of Errington's disease (Olsen, 1959) had caused the reduction of the population to approximately 10 per cent its normal size.

According to Olsen (1959), the muskrats in the Delta Marsh are a composite of the three races *O. z. zibethicus*, *O. z. cinnamominus* and *O. z. albus*. Southern Manitoba appears to be an area of intergradation between the three subspecies, and in size the Delta muskrats show the dominance of the smaller northern subspecies *albus*. In coloration, however, the *cinnamominus* component appears to dominate.

Record stations of occurrence are: 1 mile east of Delta, 1; 1.5 miles west of Delta, 1; 6 miles southeast of Delta, 1.

NORWAY RAT *Rattus norvegicus* (Berkenhout). According to reports of residents rats have not occurred in the Delta area for many years. There is a single skin in the Delta Waterfowl Research Station Collection.

HOUSE MOUSE *Mus musculus* Waterhouse. This species was rare in inhabited situations at Delta. One was taken from the duck hatchery at the Research Station on July 19.

MEADOW JUMPING MOUSE *Zapus hudsonius* (Zimmermann). In Minnesota Quimby (1951) found jumping mice to be more common in the moist lowlands than in drier lowlands, and Tamsitt (1960) found the favored habitat to be hydrosere communities near streams and lakes in Riding Mountain National Park, Manitoba. In the Delta area, however, this mouse was taken only in dry upland situations and never in moist habitats. On the beach ridges near Delta, jumping mice inhabited the higher portions in association with *Clethrionomys gapperi* and *Peromyscus maniculatus*.

Four adult females were collected near Delta in June; they were from upland areas dominated by Manitoba maple. Krutzsch (1954) records one specimen from Delta. Two adult specimens from Delta are in the Delta Waterfowl Research Station Collection.

COYOTE *Canis latrans* Say. Although none were seen on the Lake Manitoba beach ridges, coyotes do roam in areas south of the Delta Marsh. In late June Richard Phillips heard several calling one morning. Occasional individuals have been seen from time to time by farmers of the area.

TIMBER WOLF *Canis lupus* Miller. In past years the abundance of the wolves in the area has varied, but populations are controlled to a considerable extent by local residents. H. A. Hochbaum stated that tracks of these animals have been seen on the beach ridges east of Delta, and this is entirely possible if the animals moved across the frozen lake during the winter months and became stranded after the spring thaw. No tracks or signs were seen during the summer of 1958, but two large wolves were killed the previous winter near East Meadow, a goose sanctuary located on the southeast shore of Lake Manitoba.

An early record of this species is that of Gresham (1938), who recorded that a large wolf was killed in November 1937 at Dacotah, a hamlet 30 miles southeast of Delta. The Great Plains gray wolf (*C. l. nubilus*) formerly ranged across the Great Plains region from southern Alberta through southwestern Manitoba (Miller and Kellogg, 1955; Young and Goldman, 1944), but it is probably now extinct in Manitoba. The Dacotah locality may be one of the last *nubilus* records but is more likely *griseoalbus*, the subspecies that invades the Delta Marsh from the north.

RED FOX *Vulpes vulpes* (Linn). Individuals of this holarctic species (see Churcher, 1950) were common in the Delta Region. During June and July a family of four young foxes and an adult were frequently seen on an oak ridge 1.5 miles south of Delta. Another family of three young foxes and an adult were seen by H. A. Hochbaum in July five miles southwest of Delta. On June 12, a skull of a red fox was found 3.5 miles south of Delta by Richard Phillips.

RACCOON *Procyon lotor* (Linnaeus). The raccoon reaches the northern limit of its range in southern Manitoba, and although the animal has been exterminated in many districts, populations are well established in the Delta region. During June and July tracks were seen in various localities along the edge of the marsh; and on July 26, four young raccoons were seen by Richard Phillips in a tree 1.3 miles east of Delta. On August 6 Jennifer Walker saw two young individuals near the south shore of the marsh, four miles southeast of Delta.

The animal was recorded from the area for the first time when tracks were seen at Delta by Aldo Leopold in 1939. In August 1940 a young raccoon was found in the Delta Marsh by Sowls (1949), and in February 1948 Sowls (1949) obtained two additional specimens from an oak grove south of Delta.

MARTEN *Martes americana* (Turton). One record of this species in the Delta area has been provided by Hagmeier (1956). This animal was captured from a poplar grove near the Research Station during the winter of 1951-1952.

ERMINE *Mustela erminea* (Merriam). A mumified specimen was recovered from a muskrat burrow four miles south of Delta on July 10. In early May an adult and several young were seen in the vicinity of

the Research Station, and several times during the summer months an individual was seen in the duck hatchery. Two adult specimens from Delta are in the Delta Waterfowl Research Station Collection.

LEAST WEASEL *Mustela rixosa* (Bangs). This weasel is recorded by Soper (1946) from Delta and from the Big Grass Marsh northwest of Delta, and Hall (1951) reported specimens from Gypsumville and Lake St. Martin Reserve in southern Manitoba.

LONG-TAILED WEASEL *Mustela frenata* Lichtenstein. In early June a long-tailed weasel was seen crossing the east beach road one mile east of Delta; and on August 1, an individual was seen in a clearing among *Phragmites* immediately south of the Research Station. Sanderson (1949) trapped a female from a sandy ridge near Delta, and Sowls (1948) observed a long-tailed weasel killing a Franklin's ground squirrel after having taken it from its hibernating burrow. One specimen of this species from Delta is in the Delta Waterfowl Research Station Collection, and Hall (1951) has additional records from Portage la Prairie, Carberry, Carmer and Max Lake, Turtle Mountain.

MINK *Mustela vison* Schreber. An adult female was obtained on August 8 at Fort White, four miles southwest of Winnipeg. No specimens were seen or trapped at Delta in 1958. According to Olsen (1959) mink populations in the Delta Marsh were low in 1956 and 1957, with seven to 10 adult females in residence along the beach ridge and up to 25 or 30 hunting through the marsh during the winter.

BADGER *Taxidea taxus* (Schreber). Between 1934 and 1943 Soper (1946) saw only a few scattered signs of badger in southern Manitoba. Although the species apparently was common a few years ago in the Delta Region, previously inhabited burrows were found to be abandoned in 1958.

STRIPED SKUNK *Mephitis mephitis* (Schreber). Skunks were quite common in the Delta Marsh and were most commonly seen on dirt roads at dusk and toward sunrise. Records of occurrence are: 1 mile south of Delta, 2; 3 miles east of Delta, 1; 4 miles west of Minnedosa, 1.

WHITE-TAILED DEER *Odocoileus virginiana* (Zimmermann). According to Seton (1909) this deer first entered Manitoba in 1880 and since then has steadily increased in number until the animal is common to abundant in prairie areas of southern Manitoba. This species was often seen on the beach ridges of Lake Manitoba, and tracks were seen in other areas adjacent to the Delta Marsh.

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EIGHTH CENSUS OF NON-PASSERINE BIRDS IN THE BIRD SANCTUARIES ON THE NORTH SHORE OF THE GULF OF ST. LAWRENCE

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The eighth quinquennial census of non-passerine birds in the sanctuaries on the North Shore of the Gulf of St. Lawrence was conducted during the period of June 16 to June 29, 1960. Transportation was provided by the Royal Canadian Mounted Police ship "Irvine", which left Rimouski June 15 and returned on July 1. We enjoyed good weather most of the time and so were able to complete the census in a relatively brief period. The ship's crew was very co-operative and even assisted with the field work. I was assisted also by Mr. John Pippy, a student from Memorial University, St. John's, Newfoundland.

The census was carried out about two weeks later than the seventh census, conducted in 1955, to insure that all the birds would be nesting at the time of our visit. This change in dates proved to be desirable, except that the eggs of the Red-throated Loons had all hatched prior to our arrival.

TABLE 1. — CENSUS OF NON-PASSERINE BIRDS IN THE BIRD SANCTUARIES ON THE NORTH SHORE OF THE GULF OF ST. LAWRENCE
1955 – 1960

Species	Caroussel Island		Birch Islands		Betchouane		Watshishu		Fog Island		Wolf Bay		St. Mary's Islands		Mecatina		St. Augustin		Bradore Bay		Totals	
	1955	1960	1955	1960	1955	1960	1955	1960	1955	1960	1955	1960	1955	1960	1955	1960	1955	1960	1955	1960	1955	1960
Red-throated Loon									24	3	4	10	16	8	24	8	14	22			82	51
European Cormorant													678	555							678	555
Double-crested Cormorant	240	200	0	12			270	250			180	101	14	0	26	0					730	563
Black Duck			0	13			30	0	8	2			1	2	2	4	20	0			61	21
Pintail			0	2	0	1	0	3	2	0											2	6
Green-winged Teal													2	5							2	5
Common Eider	130	172	1970	2025	1580	705	430	1492	910	985	1126	1620	1450	2648	142	263	950	1120			8688	11030
Red-breasted Merganser	0	1	0	3					0	3	30	0							6	0	36	7
Semipalmated Plover									0	5			1	7			0	1	4	2	5	15
Spotted Sandpiper	2	0	26	0	6	10	0	21	24	36	12	7	16	28	8	2	2	0	16	10	112	114
Great Black-backed Gull	2	7	54	64	64	62	190	307	268	293	248	494	748	405	56	114	90	145	4	0	1724	1891
Herring Gull	1450	2410	1330	1200	724	850	66	165	66	55	364	1200	1032	1585	276	387	1184	3080			6492	10932
Ring-billed Gull					714	500			1762	135	0	466					314	1300			2790	2401
Kittiwake	178	249	0	250	120	0															298	499
Common and Arctic terns			176	260	2	3	128	561	82	162	44	82	8	230	0	44	10	0			450	1342
Caspian Tern									76	45											76	45
Razor-billed Auk	25	34			444	315	34	33	50	49	8030	9240	3906	5445					6000	1100	18489	16216
Common Murre									670	0	2054	1075	7070	10570					2500	150	12294	11795
Black Guillemot	145	125	20	40			18	17	126	136	100	14	312	390	200	184	70	114			991	1920
Common Puffin			0	1	232	205			2	7	9670	11240	2538	4838					49258	7180	61700	23471
TOTALS	2172	3198	3576	3870	3886	2651	1166	2849	4070	1916	21862	25549	17792	26716	734	1006	2654	5782	57788	8442	115700	81979

The procedure used was that described by Lewis (1942) and modified by Lemieux (1956). The census was taken by counting the birds present, without trying to estimate the number of birds away fishing or breeding. Estimation of birds not actually present would seem to be too subjective a procedure, taking into account that the census is often conducted by different people in different years. Estimates presented herein and by Lemieux are thus conservative.

The total number of birds counted in 1960 was 81,979, a drop of 29 per cent from 1955 and 17 per cent from 1950. The bird population had increased in seven sanctuaries and decreased in three; the decline in the whole population resulted, in great part, from the 90 per cent drop in the puffin colony of Bradore Bay Bird Sanctuary. Common Eiders had increased by 26 per cent, Herring Gulls by 65 per cent, Common and Arctic terns by 200 per cent. Except for Common Puffins, which had decreased by 62 per cent, the other species were holding their own, and only slight changes were noted.

On Caroussel Island Bird Sanctuary, the total population had increased by almost 50 per cent. The increase was due to a higher number of Herring Gulls and Kittiwakes. Other species showed only slight variations, mostly upward from 1955.

The bird population in the Birch Islands Sanctuary was almost exactly the same as in 1955, except for the appearance of a small colony of 250 Kittiwakes.

The Betchouane Sanctuary showed a sharp decrease in the number of eiders, and the colony of Kittiwakes which was there at the last census had disappeared. No significant changes in the other species were noted. We observed some evidence of egging, and we suspect that this might have been the cause of the decrease in population.

All species showed a sharp increase in Watshishu Sanctuary, particularly eiders, gulls, and terns. This Sanctuary, which had been constantly deteriorating for ten years, may recover following the closing down of a mine at Baie Johan Beetz which was bringing heavy boat traffic into the area. We also had the opportunity to observe carefully a Black Tern which had joined some 200 Common Terns in a colony.

In Fog Island Sanctuary, the population showed a 50 per cent drop since 1955. This was the result of the disappearance of a colony of Common Murres and a 90 per cent decrease in the Ring-billed Gull colony which probably had moved elsewhere. Only slight variations were noted for other species. This Sanctuary was without a caretaker for two seasons and this may account for the wiping out of the murre colony.

Wolf Bay Bird Sanctuary is one of the best on the North Shore. Eiders, Herring and Great Black-backed gulls, terns, auks, and puffins showed an increase, while murres, Double-crested Cormorants, and Black Guillemots decreased. A new colony of Ring-billed Gulls has established itself on one of the islands. The total bird population has grown by 15 per cent.

St. Mary's Islands Bird Sanctuary also showed a sharp increase. Eiders, Herring Gulls, terns, auks, murres, and puffins were in substantially greater numbers, whereas slightly lower numbers of European Cormorants and Great

Black-backed Gulls were observed. No Double-crested Cormorants were noted, but it is possible that some were missed among the European Cormorants. Here again, as everywhere, all the Red-throated Loons had finished nesting and a few broods were seen. The pair of Thick-billed Murres has not been observed this year.

The Mecatina Sanctuary, which had been deteriorating for many years, seems to be holding its own now. We noted a slight upward trend in most of the species, even though only a total of 1000 birds was observed. A few terns have made their appearance and bred this year, but the cormorants have left.

The bird population of St. Augustin Sanctuary had more than doubled. This increase was due mostly to the establishment of a new Ring-billed Gull colony and to the continued growth of the Herring and Great Black-backed gull populations. The eider stock was also slightly better. No Black Ducks or terns were observed this time.

The tenth and last sanctuary, Bradore Bay, has taken an alarming dip. This Sanctuary had 57,000 birds in 1955 and 8,000 in 1960. All species have suffered — auks and murres, and particularly puffins. We are unable to explain this phenomenon. Many things may have happened since 1955 when the Sanctuary was last visited by a biologist. Two years without a caretaker and the appointment of a new one make it impossible to know whether the sharp decline happened gradually or suddenly. It is hard to believe that poaching alone could have had this effect, since no evidence of digging or disturbance could be found. There is a possibility that puffins may live in discrete populations. In that case, the whole population may have moved somewhere else or been wiped out at sea by oil pollution on the east coast of Newfoundland. At any rate, the situation will be watched closely every year from now on to check whether or not this puffin colony will recover.

In summary, species showing an increase in 1960 included Common Eider, Herring Gull, Kittiwake, Common and Arctic terns, and Black Guillemot. Decline of some importance has been found for Common Puffin, Common Murre, Razor-billed Auk, Caspian Tern, Double-crested and European cormorants. The other species occurred in numbers comparable to 1955 — Spotted Sandpiper, Great Black-backed Gull, Ring-billed Gulls — or their numbers were too small to have any significance.

To conclude, we may say that the general situation is good. We note, however, that the three sanctuaries which show a decrease in bird number are all locations where caretakers had to be replaced, which means a period of one or two years without anybody on the spot. This seems to point to the importance of good supervision and enforcement.

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SOME NEW DATA ON INTROGRESSION IN FLICKERS FROM BRITISH COLUMBIA*

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In 1843 Audubon illustrated *Colaptes ayresii*, which was later recognized as a hybrid or intermediate between *C. cafer* and *C. auratus* (Baird *et al*, 1860). Since then, Flicker hybrids have been found to be widely distributed through North America, mainly in the Great Plains and the Great Basin. Many workers (e.g. Allen, 1892; Short, 1959) have discussed the distribution, variation, and relationships of such forms.

In this study are discussed some of the variations in a group of nestling and adult Flickers handled for banding in the Cariboo district of British Columbia, near the center of the hybrid zone. The Flickers breeding in that region have been described (Munro and Cowan, 1947) as *C. cafer* with an infusion of *C. auratus* blood.

The present data were collected while the writer was working as a graduate student in the Zoology Department of the University of British Columbia, under Wildlife Fellowships from Canadian Industries Limited. Thanks are extended to W. D. McLaren and to M. T. Myres, for permission to use their Flicker data in this paper, to A. J. Wiggs, for assistance in the field, and to L. L. Short, for helpful discussion during the preparation of the manuscript.

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TABLE 1. — FLICKERS EXAMINED IN THE CARIBOO DISTRICT, BRITISH COLUMBIA

Bander	Year	No. Adults	No. Nestlings	No. Broods*
Myres	1955	0	17	3(1)
Erskine	1958	7†	90	16(3)
	1959	6†	45	10(5)
McLaren	1959	1	25	6(2)
Total		13†	179	35(11)

* The number of broods in which not all young were examined is given in parentheses.
† One adult was examined both in 1958 and 1959.

HYBRID CHARACTERS

Allen (1892) listed seven characters distinguishing *C. cafer* from *C. auratus*, and Short (1959) used six of those in computing "hybrid indices". Several of those characters, however, are not suited to objective estimation except in comparison with selected series of specimens. Deakin (1936) used only four characters: colour of wing and tail linings, of malar stripes, of throat, and of the nuchal region, and the same four were used in the present study. It was not possible here to make fully objective estimations of throat colour in the field with no specimens for comparison, and data for that character are rather unsatisfactory.

Besides variations due to hybridization, black malar stripes in *C. auratus* occur only in males among adults, but are said to occur in nestlings of both sexes, (Allen, 1892). Burns (1900) stated that nestling females of *C. auratus* have a narrower nuchal bar than have males. Differences between the sexes in *C. cafer* are considered to be parallel in nestlings and in adults, males having red malar stripes and females brown, fawn, or gray stripes, often little differentiated in colour from adjacent areas.

MATERIALS AND METHODS

Table I lists the birds examined for hybrid characters during banding, near 100 Mile House, Springhouse, and Riske Creek, in British Columbia. Myres' data were gathered independently, and are not completely comparable with the rest, but have been used where possible.

In this study, three classes in colour of wing and tail linings – red, orange, and yellow – were distinguished. Seven classes of malar stripe colour – 0, 10, 25, 50, 75, 90, and 100 percent of red, and six levels of expression of the nuchal bar – 0, 5, 25, 50, 75, and 100 percent – were used. Five classes in throat colour – 0, 25, 50, 75, and 100 percent of fawn or gray – were listed, although assignment to a given class was sometimes less certain than for the other characters.

TABLE 2. — OCCURENCE OF MALAR STRIPES OF DIFFERENT COLOURS

	Malar Stripe not black or red (females)	Malar Stripe black and/or red (% red) (males)						
		0	10	25	50	75	90	100
Complete Broods (a)	19	5	1	4	5	4	3	15
(b)	42	2				3		49
Partial Broods	9	1	2		1	4	4	5
Totals	70	8	3	4	6	11	7	69

(a) critical examination; (b) uncritical examination.

RESULTS AND DISCUSSION

1) The apparent sex ratio was obtained on the assumption that only males showed either red or black in the malar region. Examination for this character was at first uncritical. The distribution by colour classes is given in Table 2. The overall total gives an apparent sex ratio of 109 males to 70 females, a ratio of 156:100, but that figure includes the uncritical data. Furthermore, on several occasions it was noted that females were less docile during handling, and tended to leave the nest first when fledging took place; inclusion of data for partial broods may thus also introduce inaccuracies. The apparent sex ratio for the ten complete broods examined critically is 37 males to 19 females, or 195:100, which departs significantly ($p < 0.05$) from an even sex ratio. That suggests that the original assumption is incorrect, and that some females may show red and/or black in the malar region.

Nestlings with completely black malar stripes are said to be distributed equally between the sexes in *C. auratus*, so the birds with black malar stripes may include some females. One may also compute sex ratios using other criteria, based upon colour of malar stripes, as indications of each sex, and that is done in Table 3. From those data, it appears probable that some birds showing small amounts of red in predominantly black malar stripes may be females, and the sex ratio is probably less unbalanced than it appeared at first sight.

2) The expression of the nuchal bar appeared to be linked to the colour of the malar stripe. Only one bird having neither red nor black in the malar region had even a 50 percent expression of the nuchal bar, whereas over half of the "males" had 50 percent or greater expression. Varying combinations of malar stripe colour are tabulated against the expression of the nuchal bar in Table 4. In view of the scatter away from the "*cafer-auratus* axis", those two hybrid characters probably vary independently. On the other hand, it is also

TABLE 3. — SEX RATIOS CALCULATED ON VARIOUS CRITERIA OF SEX*

Males are those whose Malar Stripes show	Number of		Sex Ratio M:100F	X^2 (chi-square)
	Males	Females		
any red or black	37	19	195:100	5.79
any red, and half those with all black	34	22	155:100	2.57
over 10% red, and half of others with some black	34	22	155:100	2.57
over 25% red, and half of others with some black	32	24	133:100	1.14
over 50% red, and half of others with some black	29	27	107:100	0.07
over 75% red, and half of others with some black	27	29	93:100	0.07
all red, and half of others with some black	26	30	87:100	0.29

* Data for complete broods examined critically.

TABLE 4. — EXPRESSION OF THE NUCHAL BAR RELATIVE TO MALAR STRIPE COLOUR*

Percent Red in Malar Stripe		Nuchal Bar						
		0	5	25	50	75	100	
	cafer							
90-100		6	1	3	1	8	7	
75		2	1	2	1	1	1	
50			3		2	1		
25					2	2		
5				1	1		1	
0		4	2					
								auratus
no red or black in malar stripe		16	6	5	1			

* Only critical data for malar stripe colour.

apparent that expression of the nuchal bar is repressed, not only in birds lacking red and black in the malar region (females), but also in the classes having a little red in predominantly black malar stripes. Besides suggesting that the nuchal bar is repressed in female Flickers, those data also lend support to the hypothesis that some birds having mixed red and black malar stripes may be females.

Some data on variations of nuchal bar expression within a family group appear to be significant. Among 24 complete broods, only four had all birds with less than 25 percent expression of the nuchal bar, and in all of those broods no birds showed any trace of red on the nape. Presumably both parents of those broods lacked the genes for red colour in the nuchal region. Of 11 partial broods, five had all young with 25 percent or less of nuchal bar, and three of those broods had all birds with no trace of red on the nape. It seems evident that the genes for the nuchal bar show great variation in expressivity, so that only if such genes are absent will all young show less than 25 percent expression.

The female parents of three banded broods were handled, and female parents of three others were seen; eight male parents were seen, of which four were handled. Female parents gave rise to four, out of a total of 13, female offspring (31 percent), with more expression of the nuchal bar than they themselves showed, but 15 of 21 male offspring (71 percent) showed more red than did their mothers. Male parents had eight, out of 20, male offspring (40 percent) having more red in the nuchal region than had their parent, whereas none of the 13 female offspring had more red than had their fathers. This again tends to confirm the greater expression of the nuchal bar in male birds.

3) The colour of the wing and tail linings varied very little in the sample examined. Only three birds, one handled by Erskine and two by McLaren, were felt to warrant use of the term "orange". Finer variations in colour of wing and tail linings may be detectable only by comparison with a museum series.

4) In the sample studied, *cafer* characteristics predominated, but not all characters were equally skewed to the *cafer* end of the scale. With the 50 percent class (orange in the case of colour of linings) taken as neutral, percentages of the other estimations on the *cafer* side of the mid-point were computed, as follows: colour of linings 91, colour of throat 89, expression of nuchal bar 70, colour of malar stripe (critical estimations only) 67. Differences between the sexes were significant only in the case of the nuchal bar. Possibly a more critical study might modify the values for colour of linings and of throat towards the level found for the characters receiving particular attention in this study.

Among birds actually handled, 7 of 13 adults, and 58 of 179 nestlings, were phenotypically pure *C. cafer*, if the rather unsatisfactory data on throat colour are not considered. Throat colour estimates were available for only about one-third of the birds examined. Of three adults considered as pure *cafer* on other characters, one had some fawn in the otherwise gray throat; no

less than 14 out of 20 nestlings otherwise classed as *cafer* showed some fawn throat colour. It is possible that variations due to age and plumage development make use of that character unsuitable for nestlings.

SUMMARY AND CONCLUSIONS

A group of Flickers, chiefly nestlings, from British Columbia have been examined for hybrid characteristics. A study of the data suggests the following conclusions:

1) Unbalance in the apparent sex ratio among nestlings may be brought about by the occurrence of some female birds having some red in predominantly black malar stripes, such birds being classed as hybrid males at first sight.

2) The nuchal bar is strongly repressed, both in obvious female birds, and in birds having small amounts of red in predominantly black malar stripes.

3) The Flickers in the study area show a preponderance of *C. cafer* characteristics, but most birds show some influence due to *C. auratus*.

4) Taken together, the data here presented suggest that external morphology is an unsafe indication of the sex of all Flickers showing intergradation between *Colaptes cafer* and *C. auratus*. Sex determinations of Flickers banded in the hybrid zone should be used with extreme caution.

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STUDIES ON CRUSTACEA OF THE RED SEA

The important work by O. Paul'son, *Studies on Crustacea of the Red Sea with notes regarding other seas. Part I. Podophthalmata and Edriophthalmata* (*Cumacea*) (Izsledovaniya Rakoobraznykh Krasnago Morya s Zametkami otnositel'no Rakoopraznykh drugikh morei), Kiev, 1875, has recently been translated into English by Francis D. Por and published for the National Science Foundation and Smithsonian Institution by the Israel Program for Scientific Translations. Copies may be obtained for $1.75 from the Office of Technical Services, U.S. Department of Commerce, Washington 25, D.C. (OTS-60-21821).

OBSERVATIONS ON THE FOOD OF THE BLUE-TAILED SKINK IN RONDEAU PARK, ONTARIO

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During the period September 20 to 25, 1959, seven skinks (*Eumeces fasciatus*) were captured at three locations in Rondeau Park, Kent County, Ontario. This park is a sandy point, about six miles long, extending southward into Lake Erie. The peninsula is about a quarter of a mile wide at its base and broadens out towards its southerly tip, which is about a mile and a half wide. The first skink was found in the north end of the park under the bark of a white pine stump, and the second under the bark of an oak log about a mile from the base of the park. The other five skinks were captured in a large trash pile on the south side of Dillon Trail, which runs across the park near its southerly tip. All seven were young males with characteristic azure-blue tails and distinct yellowish stripes on a black body.

After being killed with cyanide the skinks were dissected and the three parts of the digestive tract, the esophagus and stomach together, the midgut and the rectum, were snipped out separately. The ingested food was removed and the recognizable items found in the seven skinks are shown in Table 1.

The food of the skinks consisted of 18 items: 11 crickets, 2 snails, 2 spiders, 1 cockroach, 1 sow bug and 1 caterpillar. The crickets were too greatly broken up to be identified from their external features but five of them were found to be *Nemobius* sp. by examining the structure of the gizzards and using keys and descriptions in Judd (1948). The two snails were 2 mm and 4 mm in diameter and their shells had been dissolved, leaving only the coiled bodies. The spiders were *Xysticus* sp. and *Trochosa pratensis* (Emerton), identified by Dr. C. D. Dondale, Research Station, Department of Agriculture, Kentville, Nova Scotia. Comstock (1948) reports that crab spiders of the genus *Xysticus* live under stones and leaves or under loose bark and that *T. pratensis* is a common species found under stones in the northeastern part of the United States and in Canada. The cockroach was *Parcoblatta pennsylvanica* (Deg.), a common species in Rondeau Park (Judd, 1957). The sow bug was identified as *Porcellio rathkei* (Brandt) (Walker, 1927). The remains of the caterpillar were 8 mm long and consisted of the head, thorax and a few abdominal segments. Only in the esophagus and stomach of the skinks were any invertebrates intact.

The six different items of food found in the skinks were also found previously to be food of Jefferson's salamander in Rondeau Park (Judd, 1957). The chief difference in the food of the two animals was that snails were the commonest food found in the salamander whereas crickets were commonest in the skinks. The predominance of crickets, spiders and cockroaches in the food of the skinks bears out the observations by Judd (1955, 1957) and Fitch

TABLE 1. — FOOD IN THE DIGESTIVE TRACT OF SEVEN SKINKS

Skink	Stomach	Intestine	Rectum
1	1 *Parcoblatta pennsylvanica;* head and forewing of cricket	segments of insect leg	eggs and leg segments of cricket
2	empty	empty	head and thorax of caterpillar; wings and sclerites of cricket
3	1 *Xysticus* sp.	empty	empty
4	sclerites of insects	empty	2 snails; wings sclerites, ovipositor and eggs of cricket
5	sclerites, eggs and gizzard of 1 *Nemobius* sp.	empty	integument, epigynum and leg segments of *Trochosa pratensis*
6	heads, wings, ovipositors, eggs and gizzards of 4 *Nemobius* sp.	head, eggs and sclerites of 1 cricket	heads, sclerities and leg segments of 2 crickets
7	1 *Porcellio rathkei*	empty	empty

(1954) that active creatures form the bulk of the diet and that slow or motionless invertebrates are generally left untouched.

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THE COMPARATIVE NUMBER OF SPECIES OF AMPHIBIANS IN CANADA AND OTHER COUNTRIES

II. SUMMARY OF SPECIES OF CAECILIANS AND SALAMANDERS

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The present paper is a continuation of the author's previous (Gorham, 1957) work. (The third and final section which deals with frogs and toads is now being compiled).

In this work an attempt has been made to include the names of all valid species of caecilians and salamanders up to the year 1957. (Part 1 contained the names up to the end of 1954 only). The subspecies and synonymous names have not been included. Names that have been synonymized and later revived are preceded by a "?" mark. If the species contains two or more subspecies the number is marked following the specific name, ex. (2r). This would include the nominate plus one other race.

Boulenger (1882, 1895) revised all the genera and species of caecilians known at the time. Nieden's (1913) work was the last complete checklist of the caecilians of the world. Dunn (1942) monographed the American forms and since that time five new species have been described: Dunn (1944) one from Colombia; Dunn (1945) one from Brazil; Taylor (1955) under the generic name *Dermophis*, three from Costa Rica. I have followed Dunn's (1942) work in using the name *Gymnopis*, rather than *Dermophis*, since Dunn was the last revisor. Subspecies, synonymies, keys and range are included in Dunn's (1942) work. There is no recent complete checklist of the Asian caecilians. However, since Nieden (1913) up to the year 1957 only four new species have been described: Annandale (1913) one from India; Taylor (1920, 1923) two from Philippines, both of which have been synonymized by Inger (1954); Seshachar (1939) one from India. Noble (1924) provided a checklist of the African species; and Loveridge (1957) treated all the East African forms. Parker (1927) reviewed the genus *Geotrypetes* and reduced *G. petersii* to a synonym. Parker (1936) described a new species from French Guinea and (1936a) a new genus and species from the Cameroons. The species of the Seychelles are covered fully by Parker (1941, 1958).

Except for Boulenger's (1882) monograph there does not appear to be any recent complete checklist of the salamanders of the world. Dunn (1926) monographed the family Plethodontidae; and Taylor (1944) revised the genera and species found south of U.S.A. Dunn (1923) monographed the family Hynobiidae. Wolterstroff and Herre (1935) revised the family Salamandridae. The checklist for North America is Schmidt (1953). Smith & Taylor (1948) is available for Mexico. Other Central American countries are covered by the following authors: Stuart (1943) Guatemala; Schmidt (1941) British Honduras;

Dunn & Emlen (1932) Honduras; Mertens (1952) El Salvador; Taylor (1952) Costa Rica; Dunn (1931) Panama. For Europe, Mertens & Müller (1940) is the basic checklist. Terentjev & Tschernov (1949) covers those species found in U.S.S.R. There is no complete checklist for Asia, however certain countries are covered by the following authors: Sato (1943) Japan; Pope & Boring (1940) and Liu (1950) China; Inger (1947) Ryukyu Islands; Bourret (1942) Indochina; Boulenger (1890) India; Bodenheimer (1944) Asia Minor; Mendelssohn & Steinitz (1944) Israel. Noble (1924) is the basic checklist for Africa. The three species of African salamanders are found north of the Sahara.

The Zoological Record, published yearly since 1864, is the best single source of information available. In compiling this list I have checked all the Records (Amphibia and Reptilia section) from 1881-1956.

A bibliography of the more important checklists, catalogues and monographs which were consulted will be found in part I (Gorham, 1957).

With regard to the distribution of the American caecilians the majority of the species are found south of Panama, but the following are known north of Colombia: *Gymnopis costaricense*, *glandulosus*, *mexicana*, *multiplicata*, *oligozona*, *parviceps* and *Caecilia tentaculata* (the latter species being found both in Panama and Columbia). The opposite situation occurs with the American salamanders, by far the greatest number being found north of Columbia. The following species, however, are found south of Panama: *Bolitoglossa altamazonicus*, *?andicola*, *?paraensis*, *?peruviana; Magnadigita adspersa; Oedipina parvipes.*

The author is not familiar with all the literature on caecilians and salamanders that has appeared since 1957 and has not referred to any works later than that year, with the exception of Parker (1958). Several important works published since 1957 should be mentioned: Mertens & Wermuth (1960) Checklist of the Amphibians & Reptiles of Europe; Logier & Toner (1961) Checklist of the Amphibians & Reptiles of Canada and Alaska; Taylor (1960) has described a new genus and nineteen new species of caecilians from southern Asia. Mr. A Brame, Jr. (University of Southern California) has in preparation a checklist of salamanders of the world and he has kindly sent me a preliminary list of the species he considers valid. Gorham (in press) *Checklist of Caecilians* contains full synonymies for all species.

I wish to thank Mr. Francis Cook, herpetologist of the National Museum of Canada and Dr. Sherman Bleakney, Acadia University, for reading the manuscript and to Mr. Robert Hamilton, past editor of the Canadian Field-Naturalist, for helpful suggestions.

Apoda (Caecilians)

Number of species in each country:

SOUTH AMERICA: Argentina 2; Bolivia 2; Brazil 15; British Honduras 1?; Colombia 17; Costa Rica 5; Ecuador 9; El Salvador 1; Guatemala 3; Guianas 7; Honduras 2; Mexico 2; Nicaragua 2; Panama 6; Paraguay 1; Peru 8; Trinidad 1; Uruguay 1; Venezuela 3.

ASIA: Borneo 2; Burma 2; Ceylon 2; India 8; Java 2; Malaya 2; Pakistan 1?; Philippines 1; Sumatra 2; Thailand 2; Vietnam 1.

AFRICA: Belgian Congo 1; Dahomey 1; French Equatorial Africa 6; French Guinea 2; Ghana 1; Ivory Coast 1; Kenya 3; Liberia 1; Nigeria 1; Northern Rhodesia 1; Sierra Leone 1; Tanganyika 6; Seychelles 6.

List of Species by Continents

SOUTH AMERICA
(including Central America and Mexico)

Caeciliidae

Caecilia Linnaeus 1758: *abitaguae* Dunn 1942; *armata* Dunn 1942; *bassleri* Dunn 1942; *caribea* Dunn 1942; *degenerata* Dunn 1942; *dunni* Hershkovitz 1938; *elongata* Dunn 1942; *gracilis* Shaw 1802; *guntheri* Peters 1879; *nigricans* Boulenger 1902; *ochrocephala* Cope 1866; *pachynema* Günther 1859; *polyzona* Fischer 1879; *subnigricans* Dunn 1942; *tentaculata* Linnaeus 1758; *thompsoni* Boulenger 1902.

Chthonerpeton Peters 1879; *indistinctum* (Reinhardt & Lütken) 1861; *petersii* Boulenger 1882; *viviparum* Parker & Wettstein 1929.

Gymnopis Peters 1874; *albiceps* (Boulenger) 1882; *braziliensis* Dunn 1945; *costaricense* (Taylor) 1955; *glandulosus* (Taylor) 1955; *mexicana* (Duméril & Bibron) 1841 (3r); *multiplicata* Peters 1874 (3r); *nicefori* Barbour 1924; *occidentalis* (Taylor) 1955; *oligozona* (Cope) 1877; *parviceps* (Dunn) 1924; *pricei* Dunn 1944; *unicolor* (Duméril) 1863.

Rhinatrema Duméril & Bibron 1841: *bicolor* (Boulenger) 1883; *bivitatum* (Cuvier) 1829; *columbianum* Rendahl & Vestergren 1938; *nigrum* Dunn 1942; *parkeri* Dunn 1942; *peruvianum* Boulenger 1902.

Siphonops Wagler 1828: *annulatus* (Mikan) 1820; *brasiliensis* Lütken 1851; *hardyi* Boulenger 1888; *insulanus* Ihering 1911; *paulensis* Boettger 1892.

Typhlonectes Peters 1879: *compressicauda* (Duméril & Bibron) 1841 (2r); *kaupii* (Berthold) 1859.

ASIA

Gegeneophis Peters 1879: *carnosus* (Beddome) 1870.

Herpele Peters 1879: *fulleri* Alcock 1904.

Ichthyophis Fitzinger 1826: *glutinosus* (Linnaeus) 1754; *monochrous* (Bleeker) 1858.

Uraeotyphlus Peters 1879: *malabaricus* (Beddome) 1870; *menoni* Annandale 1913; *narayani* Seshachar 1939; *oxyurus* (Duméril & Bibron) 1841.

AFRICA

Boulengerula Tornier 1896: *boulengeri* Tornier 1896; *changamwensis* Loveridge 1932; *taitanus* Loveridge 1935; *uluguruensis* Barbour & Loveridge 1928.

Geotrypetes Peters 1880: *angeli* Parker 1936; *seraphini* (Duméril) 1859 (2r).

Herpele Peters 1879: *bornmuelleri* Werner 1899; *multiplicata* Nieden 1912; *squalostoma* (Stutchbury) 1834.

Hypogeophis Peters 1879: *rostratus* (Cuvier) 1829 (3r).

Idiocranium Parker 1936: *russeli* Parker 1936.

Praslinia Boulenger 1909: *alternans* (Stejneger 1893; *brevis* (Boulenger) 1911; *cooperi* Boulenger 1909; *larvatus* (Ahl) 1934; *sechellensis* (Boulenger) 1911.

Schistometopum Parker 1941: *gregorii* (Boulenger) 1894; *thomensis* (Bocage) 1873.

Scolecomorphus Boulenger 1883: *attenuatus* Barbour & Loveridge 1928; *kirkii* Boulenger 1883 (2r); *vittatus* (Boulenger) 1895.

Caudata (Salamanders)

Number of species in each country:

SOUTH AMERICA: Bolivia 1; Brazil 2?; British Honduras 2; Colombia 3?; Costa Rica 28; Ecuador 1; El Salvador 2; Guatemala 25; Honduras 2; Mexico 70; Nicaragua 8?; Panama 6; Peru 1; Venezuela 2?.

NORTH AMERICA: Canada 17; U.S.A. 84.

EUROPE: Europe 20.

ASIA: Afghanistan 1; Burma 1; China 21; Formosa 2; India 1; Iran 5; Iraq 3; Israel 2; Japan 18; Jordon 2?; Korea 3; Mongolia 1; Pakistan 1; Ryukyu Islands 3; Syria 2; Thailand 1; Turkey 7; U.S.S.R. (Asiatic) 5; Vietnam 2.

AFRICA: Algeria 2; Libya 1; Morocco 3; Tunisia 1.

List of Species by Continents

SOUTH AMERICA
(including Central America and Mexico)

Sirenidae

Siren Linnaeus 1766; *intermedia* LeConte 1827.

Ambystomidae

Ambystoma Tschudi 1838: *amblycephalum* Taylor 1939; *bombypellum* Taylor 1938; *granulosum* Taylor 1944; *fluvinatum* Taylor 1941; *lacustris* Taylor & Smith 1945; *ordinarium* Taylor 1939; *rosaceum* Taylor 1941 (3r); *schmidti* Taylor 1938; *subsalsum* Taylor 1943; *tigrinum* (Green) 1928.

Bathysiredon Dunn 1939: *dumerilii* (Dugès) 1870.
Rhyacosiredon Dunn 1928: *altamirani* (Dugès) 1895; *leorae* Taylor 1943; *rivularis* Taylor 1940; *zempoalaensis* Taylor & Smith 1945.
Siredon Wagler 1830: *lermaensis* Taylor 1939; *mexicanum* (Shaw) 1789.

Salamandridae
Diemictylus Rafinesque 1820: *kallerti* Wolterstorff 1930; *meridionalis* Cope 1880.
Taricha Gray 1850: *torosa* Rathke 1833.

Plethodontidae
Aneides Baird 1849: *lugubris* (Hallowell) 1849.
Batrachoseps Bonaparte 1839: *attenuatus* (Eschscholtz) 1833.
Bolitoglossa Duméril & Bibron 1854: *?ahli* (Unterstein) 1930; *altamazonicus* (Cope) 1874; *alvarodoi* Taylor 1954; *?andicola* (Posada) 1909; *arborescandens* Taylor 1954; *borburata* Trapido 1942; *colonnea* (Dunn) 1924; *doffleini* (Werner) 1903; *flaviventris* (Schmidt) 1936; *lignicolor* (Peters) 1873; *mexicana* Duméril & Bibron 1854; *?mulleri* (Brocchi) 1883; *occidentalis* Taylor 1941; *?odonnelli* (Stuart) 1943; *palustris* Taylor 1949; *?paraensis* (Unterstein) 1930: *?peruviana* (Boulenger) 1883; *platydactylus* (Gray) 1831; *rufescens* (Cope) 1869; *salvinii* (Gray) 1868; *schmidti* (Dunn) 1924; *striatula* (Noble) 1918; *veracrucis* Taylor 1951; *yucatana* (Peters) 1882.
Chiropterotriton Taylor 1944: *abscondens* Taylor 1948; *arborea* (Taylor) 1941; *bromeliacia* (Schmidt) 1936; *chiroptera* (Cope) 1863; *chondrostega* (Taylor) 1941; *dimidiata* (Taylor) 1939; *lavae* (Taylor) 1942; *mosaueri* (Woodall) 1941; *multidentata* (Taylor) 1938; *nasalis* (Dunn) 1924; *prisca* Rabb 1956; *terrestris* (Taylor) 1941; *xolocalcae* (Taylor) 1941.
Ensatina Gray 1850: *eschscholtzii* Gray 1850.
Magnadigita Taylor 1944: *adspersa* (Peters) 1863; *brevipes* Bumzahem & Smith 1955; *cerroensis* Taylor 1952; *cuchumatanus* (Stuart) 1943; *dunni* (Schmidt) 1933; *engelhardti* (Schmidt) 1936; *flavimembris* (Schmidt) 1936; *franklini* (Schmidt) 1936; *helmrichi* (Schmidt) 1936; *lincolni* (Stuart) 1943; *macrinii* (Lafrentz) 1930; *morio* (Cope) 1869; *nigrescens* Taylor 1949; *nigroflavescens* (Taylor) 1941; *omniumsanctorum* Stuart 1952; *pesrubra* Taylor 1952; *robusta* (Cope) 1894; *rostrata* (Brocchi) 1883; *subpalmata* (Boulenger) 1896; *sulcata* (Brocchi) 1883; *torresi* Taylor 1952.
Oedipina Keferstein 1868: *alfaroi* Dunn 1921; *alleni* Taylor 1954; *bonitaensis* Taylor 1952; *collaris* (Stejneger) 1907; *complex* (Dunn) 1924; *cyclocauda* Taylor 1952; *?elongatus* (Schmidt) 1936; *gracilis* Taylor 1952; *ignea* Stuart 1952; *inusitata* Taylor 1952; *lineola* (Cope) 1865; *longissima* Taylor 1952; *pacificensis* Taylor 1952; *parvipes* (Peters) 1879; *salvadorensis* Rand 1952; *serpens* Taylor 1949; *syndactyla* Taylor 1948; *uniformis* Keferstein 1868.
Parvimolge Taylor 1944: *praecellens* Rabb 1955; *richardi* Taylor 1949; *townsendi* (Dunn) 1922.

Pseudoeurycea Taylor 1944: *altamontana* (Taylor) 1938; *barbouri* (Schmidt) 1936; *bellii* (Gray) 1849; *brunnata* Bumzahem & Smith 1955; *cephalica* (Cope) 1865 (3r); *cochranae* (Taylor) 1943; *exspectata* Stuart 1954; *firscheini* Shannon & Werler 1955; *gadovii* (Dunn) 1926; *galaenae* (Taylor) 1941; *gigantea* (Taylor) 1938; *goebeli* (Schmidt) 1936; *leprosa* (Cope) 1869; *melanomolga* Taylor 1941; *nigromaculata* (Taylor) 1941; *picadoi* (Stejneger) 1911; *rex* (Dunn) 1921; *robertsi* (Taylor) 1938; *scandens* Walker 1955; *smithi* (Taylor) 1938; *unguidentis* (Taylor) 1941; *werleri* Darling & Smith 1954.

Thorius Cope 1869: *dubitus* Taylor 1941; *macdougalli* Taylor 1949; *minutissimus* Taylor 1949; *narisovalis* Taylor 1939; *pennatulus* Cope 1869 (2r); *pulmonaris* Taylor 1939; *troglodytes* Taylor 1941.

NORTH AMERICA

Cryptobranchidae

Cryptobranchus Leuckart 1821: *alleganiensis* (Daudin) 1802 (2r).

Proteidae

Necturus Rafinesque 1819; *maculosus* (Rafinesque) 1818 (5r); *punctatus* (Gibbes) 1850 (2r).

Sirenidae

Pseudobranchus Gray 1825: *striatus* (LeConte) 1824 (5r).

Siren Linnaeus 1766: *intermedia* LeConte 1827 (3r); *lacertina* Linnaeus 1766.

Ambystomatidae

Ambystoma Tschudi 1838: *annulatum* Cope 1886; *cingulatum* Cope 1867 (2r); *gracile* (Baird) 1859; *jeffersonianum* (Green) 1827; *mabeei* Bishop 1928; *macrodactylum* Baird 1849 (2r); *maculatum* (Shaw) 1802; *opacum* (Gravenhorst) 1807; *talpoideum* (Holbrook) 1838; *texanum* (Matthes) 1855; *tigrinum* (Green) 1825 (6r).

Dicamptodon Strauch 1870: *ensatus* (Eschscholtz) 1833.

Rhyacotriton Dunn 1920: *olympicus* (Gaige) 1917 (2r).

Salamandridae

Diemictylus Rafinesque 1820: *meridionalis* Cope 1880; *viridescens* Rafinesque 1820 (4r).

Taricha Gray 1850: *granulosa* (Skilton) 1849 (4r); *rivularis* (Twitty) 1935; *torosa* (Rathke) 1833 (2r).

Amphiumidae

Amphiuma Garden 1821: *means* Garden 1821 (2r).

Plethodontidae

Aneides Baird 1849: *aeneus* (Cope & Packard) 1881; *ferreus* Cope 1869; *flavipunctatus* (Strauch) 1870 (2r); *hardyi* (Taylor) 1941; *lugubris* (Hallowell) 1849 (2r).

Batrachoseps Bonaparte 1839: *attenuatus* (Eschscholtz) 1833 (3r); *pacificus* (Cope) 1865 (4r); *wrighti* (Bishop) 1937.

Desmognathus Baird 1850: *aeneus* Brown & Bishop 1947 (2r); *fuscus* Rafinesque) 1820 (5r); *monticola* Dunn 1916 (2r); *ochrophaeus* Cope

1859 (2r); *ocoee* Nicholls 1949; *perlapsus* Neill 1950; *planiceps* Newman 1955; *quadramaculatus* (Holbrook) 1840; *wrighti* King 1936.

Ensatina Gray 1850: *eschscholtzii* Gray 1850 (7r).

Eurycea Rafinesque 1822: *bislineata* (Green) 1818 (4r); *longicauda* (Green) 1818 (4r); *lucifuga* Rafinesque 1822; *multiplicata* (Cope) 1869 (2r); *neotenes* Bishop & Wright 1937 (4r); *troglodytes* Baker 1957; *tynerensis* Moore & Hughes 1939.

Gyrinophilus Cope 1869: *danielsi* (Blatchley) 1900 (3r); *lutescens* (Rafinesque) 1832; *palleucus* McCrady 1954; *porphyriticus* (Green) 1827 (3r).

Haideotriton Carr 1939: *wallacei* Carr 1939.

Hemidactylium Tschudi 1838: *scutatum* (Schlegel) 1838.

Hydromantes Gistel 1848: *brunus* Gorman 1954; *platycephalus* (Camp) 1916; *shastae* Gorman & Camp 1953.

Leurognathus Moore 1899: *marmorata* Moore 1899 (5r).

Manculus Cope 1869: *quadridigitatus* (Holbrook) 1842.

Plethodon Tschudi 1838: *caddoensis* Pope & Pope 1951; *cinereus* (Green) 1818 (3r); *dixi* Pope & Fowler 1949; *dorsalis* Cope 1889; *dunni* Bishop 1934; *elongatus* Van Denburgh 1916; *glutinosus* (Green) 1818 (4r); *hubrichti* Thurow 1957; *?jacksoni* Newman 1954; *jordani* Blatchley 1901 (8r); *neomexicanus* Stebbins & Riemer 1950; *ouachitae* Dunn & Heintze 1933; *richmondi* Netting & Mittleman 1938 (3r); *vandykei* Van Denburgh 1906 (3r); *vehiculum* (Cooper) 1860; *wehrlei* Fowler & Dunn 1917; *welleri* Walker 1931 (2r); *yonahlossee* Dunn 1917.

Pseudotriton Tschudi 1838: *montanus* Baird 1849 (4r); *ruber* (Sonnini) 1802 (4r).

Stereochilus Cope 1869: *marginatus* (Hallowell) 1857.

Typhlomolge Stejneger 1896: *rathbuni* Stejneger 1896.

Typhlotriton Stejneger 1892: *spelaeus* Stejneger 1892.

EUROPE

Hynobiidae

Hynobius Tschudi 1838: *keyserlingii* (Dybowski) 1870.

Proteidae

Proteus Laurenti 1768: *anguinus* Laurenti 1768 (2r).

Salamandridae

Chioglossa Bocage 1864: *lusitanica* Bocage 1864.

Euproctus Gene 1838: *asper* (Dugès) 1852 (2r); *montanus* (Savi) 1839; *platycephalus* (Gravenhorst) 1829.

Pleurodeles Michahelles 1830: *waltl* Michahelles 1830.

Salamandra Laurenti 1768: *altra* Laurenti 1768; *salamandra* (Linnaeus) 1758 (10r).

Salamandrina Fitzinger 1826: *terdigitata* (Lacépède) 1788.

Triturus Rafinesque 1815: *alpestris* (Laurenti) 1768 (6r); *boscai* (Lataste) 1879; *cristatus* (Laurenti) 1768 (5r); *helveticus* (Razoumowsky) 1789 (2r); *italicus* (Peracca) 1898; *marmoratus* (Latreille) 1800 (2r); *montandoni* (Boulenger) 1880; *vulgaris* (Linnaeus) 1758 (5r.)

Plethodontidae

Hydromantes Gistel 1848: *genei* Schlegel 1838; *italicus* Dunn 1923.

ASIA

Hynobiidae

Batrachuperus Boulenger 1878: *cochranae* Liu 1950; *karlschmidti* Liu 1950; *mustersi* Smith 1940; *pinchonii* (David) 1871; *tibetanus* Schmidt 1925; *yenyuanensis* Liu 1950.

Hynobius Tschudi 1838: *abei* Sato 1934; *chinensis* Günther 1889; *dunni* Tago 1931; *keyserlingii* (Dybowski) 1870; *kimurai* Dunn 1923; *leechii* Boulenger 1887; *lichenatus* Boulenger 1883; *naevius* (Schlegel) 1838; *nebulosus* (Schlegel) 1838; *nigrescens* Stejneger 1907; *okiensis* Sato 1940; *retardatus* Dunn 1923; *sadoensis* Sato 1940; *shihi* Liu 1950; *sonani* (Maki) 1921; *stejnegeri* Dunn 1923; *tokoyensis* Tago 1931; *tsuensis* Abe 1922.

Onychodactylus Tschudi 1838: *fisheri* (Boulenger) 1886; *japonicus* (Houttuyn) 1782.

Pachypalaminus Thompson 1912: *boulengeri* Thompson 1912.

Ranodon Kessler 1866: *sibiricus* Kessler 1866.

Cryptobranchidae

Megalobatrachus Tschudi 1837: *japonicus* (Temminck) 1837 (2r).

Salamandridae

Cynops Tschudi 1838: *chinensis* Gray 1859; *ensicaudus* (Hallowell) 1860; *orientalis* (David) 1875; *pyrrhogaster* (Boie) 1826.

Hypselotriton Wolterstorff 1934: *wolterstorffi* (Boulenger) 1905.

Martensiella Wolterstorff 1925: *caucasica* (Waga) 1876; *luschani* (Steindachner) 1891.

Neurergus Cope 1862: *crocatus* Cope 1862 (4r).

Pachytriton Boulenger 1878: *brevipes* (Sauvage) 1877.

Paramesotriton Chang 1935: *deloustali* (Bourret) 1934.

Salamandra Laurenti 1768: *salamandra* (Linnaeus) 1758 (3r).

Triturus Rafinesque 1815: *cristatus* Laurenti 1768 (3r); *vittatus* (Gray) 1835 (5r); *vulgaris* (Linnaeus) 1758 (2r).

Tylotriton Anderson 1871: *andersoni* Boulenger 1892; *?asperrimus* Unterstein 1930; *?chinhaiensis* Chang 1932; *?kweichowensis* Fang & Chang 1932; *taliangensis* Liu 1950; *verrucosus* Anderson 1871.

AFRICA

Salamandridae

Pleurodeles Michahelles 1830: *poireti* (Gervais) 1835; *waltl* Michahelles 1830 (2r).

Salamandra Laurenti 1768: *salamandra* (Linnaeus) 1758.

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THE BLADDERNUT SHRUB AT OTTAWA*

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The presence of the American bladdernut, *Staphylea trifolia*, along the Rideau River at Ottawa represents an isolated occurrence of the species at the northern fringe of its general range covering much of eastern North America. Specimens in Ottawa herbaria have been collected at various times in the past: in 1878 by James Fletcher on "river-side, Billings Bridge" and "by Whyte railroad bridge over Rideau below Hog's Back"; in 1898 by John Macoun "on an island above Billings Bridge"; in 1908 by W. H. Harrington on "moist low ground, Billings Bridge"; in 1937 by Claude Johnson "on the Rideau near Ottawa"; in 1943 by M. N. Zinck in "woods at foot of Leonard Street." All these specimens apparently come from essentially the same spot, and since they were collected independently by six different persons, it seems safe to conclude that the shrub occurs nowhere else in the Ottawa District, an area quite well worked botanically. The label data indicate moreover that the plants originally extended for about a mile along the Rideau River. They are now confined to an acre or two of alluvial woodland on its north bank a quarter of a mile above Billings Bridge at the foot of Osborne Street.

The closest other stands to Ottawa are at Casselman, 30 miles to the southeast (not collected since 1891 by John Macoun and 1911 by J. M. Macoun), at Prescott, 50 miles to the south (not collected since 1860 by Billings), and at Grenville, 55 miles to the east (collected first in 1960 by Dore, Hainault and Mulligan). These and the records cited by Raymond (1947) for Quebec and by Fox and Soper (1952) for Ontario are incorporated in the map centred on Ottawa (Figure 1). This map, together with that given by Soper and Heimburger (1961), will complete the known distribution of the species in Canada.

The 30th of October, 1960, proved to be a good date on which to relocate and study the old Rideau River stand; the leaves had just fallen and the bare shrubs, heavily laden with their browning bladdery fruits, stood out conspicuously in the patch of woodland by the river. The shrubs grouped themselves into more or less discrete groves, each with certain minor differences in height or bushiness, in abundance or shape of pods, in color of seeds, etc. The groves undoubtedly represented individual clones enlarged over the years by vegetative sprouting from the roots.

The shrubs varied in height from 7 to 10 feet and the greatest size of their trunks was about two inches; none of the dead stumps was broader. Presumably the shrubs had fruited as heavily in many previous seasons, but why had

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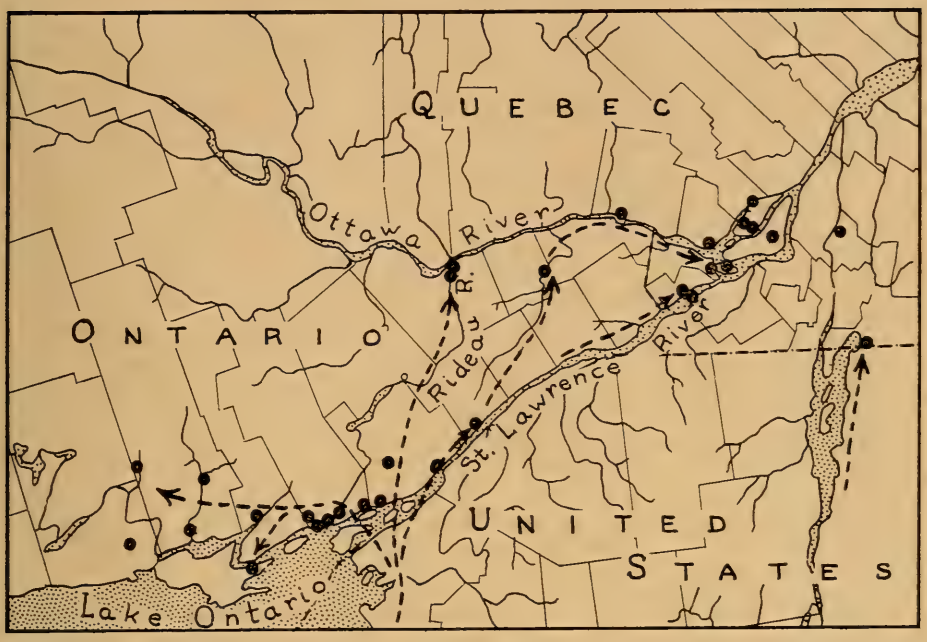

FIGURE 1. Occurrence of American bladdernut, *Staphylea trifolia*, in southeastern Ontario and adjoining Quebec as known from preserved specimens. The hypothetical routes of migration are indicated by dashed lines.

the whole woodland not grown up to a solid stand from seedlings? — and, why had not plants established all along the riverbank for miles below from the seed-bearing bladders floated down? The bony seeds after sacrification and freezing were found to be germinable. Perhaps the conditions at the present, although favorable for the persistence of establishing shrubs, were not favorable for the germination of the seeds or for the establishment of new seedlings in the wild.

The most striking of all the morphological differences was in the shape of the inflated mature fruits, broad-elliptic to obovate vs. pear-shaped with a slender-tapered base. The difference seems sharp enough to warrant formal recognition. The two shapes of fruit are illustrated in the photographs, Figures 2 and 3 respectively. Besides the difference in general outline, the sinus between the tips of the carpels is less deep and narrower in fruits with the pyriform shape. When opened, their seeds were found to have an olive-brown color in contrast to a reddish brown in those from the broad-elliptic bladders. This correlated feature, however, proved evanescent and after a few days the color of the threshed seeds from both types of bladders was the same, reddish-brown.

The Linnaean specimen of *Staphylea trifolia* consists of leaves only — at least, no flowers or fruits are visible on the photograph available in the Department of Agriculture herbarium at Ottawa. In the original description, Linnaeus

(1753) gives us no information to help us know what shape of pod is typical of the species. The prevalent shape on specimens from the eastern States (which would include the "Virginia" from which his plant came), however, is broad-elliptic, so we can take this as characteristic of forma **trifolia.** Plants bearing the other pod-shape, the pryiform pod tapering slenderly to the base with only a narrow space between the carpellary tips and suspended on a slightly upward-thickened pedicel, may be named as follows:

Staphylea trifolia L., forma **pyriformis** n.f. *Fructus maturus pyriformis.*
The type specimen deposited in the herbarium of the Department of Agriculture, Ottawa (Herb. DAO), consists of pressed fruits with other portions taken from the same marked shrub the next season. The label data read: alluvial woods along Rideau River at foot of Osborne Street, Ottawa, Carleton County, Ontario, Canada; fruits, October 30, 1960, No. 18872A W. G. Dore & C. Frankton; flowers, May 31, 1961, No. 18872B W. G. Dore; leaves, July 15, 1961, No. 18872C W. G. Dore.

Other plants of forma **pyriformis** represented by specimen are: No. 18875 W. G. Dore from site (DAO); on the Rideau River near Ottawa, November 6, 1937, Claude E. Johnson (CAN); au bord de la route, Saint Armand, Compte Missisquoi, 15 juin 1941, No. 56443 Marie-Victorin et al. (CAN). Numerous specimens of the typical form, forma **trifolia,** are available in herbaria, but Nos. 18873 and 18874 from plants at the Rideau River site have been made particularly to illustrate the contrast. Perhaps it is timely to state that the current filling of the land along Osborne Street for building purposes threatens to exterminate all the remaining shrubs. An attempt is therefore being made to propagate them by seeds and cuttings for conservation in the Arboretum at the Experimental Farm.

The elimination of this natural site at Ottawa would be regrettable also from the standpoint of several other interesting species associated with the bladdernuts, more or less localized there: *Menispermum canadense, Zanthoxylum americanum, Celtis occidentalis, Elymus wiegandii, Helianthus tuberosus* and *Rhus radicans* (the high-climbing variety). A short distance upsteam some other rare species occur: *Andropogon scoparius, Andropogon gerardii* (until 1943), *Sorghastrum nutans, Apios americana, Acer nigrum, Desmodium canadense, Lycopus asper* and *Samolus floribundus.* The occurrence of such an assemblage brings up the question of its origin and persistence at the particular vicinity. Some of the species, the Jerusalem artichoke, groundnut, hackberry, bladdernut, prickly-ash, tick-trefoil and Indian grass for example, might have been transported to the site by the aborigines as food or for ceremonial purposes, or just dropped there accidentally. The broad flat at the foot of the Hog's Back rapids could have provided a good portage and camping site for the Indians in their travels between Lake Ontario and the Ottawa River, so perhaps aboriginal transport is the answer.

On the other hand, there are several species in the assemblage which would not likely be carried in this way. All of them, however, have unit floristic

FIGURE 2. The broad-elliptic fruits typical of the American bladdernut, *Staphylea trifolia* forma *trifolia*, from Rideau River site at Ottawa. Specimen No. 18873A, ½ natural size.

FIGURE 3. Pear-shaped fruits of *S. trifolia* forma **pyriformis** from a shrub at the same site. Type specimen No. 18872A; ½ natural size.

affinity – with a more southern flora – and it is just as plausible that they might have spread northward together by ordinary means at a time when the climate was more favorable. They would then represent a relict community persisting in a sedentary state at that particular site by virtue of the local conditions created by the continuing shoreline processes of the river.

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SORBARIA SORBIFOLIA (L.) A. BR., FALSE SPIRAEA, PERSISTING AND SPREADING AFTER CULTIVATION IN CANADA*

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Sorbaria sorbifolia (L.) A. Br., a native shrub of eastern Asia, has been cultivated sparingly in eastern Canada for many years. It is now found in cultivation mainly in old gardens and is only rarely planted in new situations.

The first report of the occurrence of *Sorbaria sorbifolia* outside cultivation in Canada was that of James M. Macoun (1898) "Along roadsides near Baddeck, Cape Breton Island, N.S. 1898 (John Macoun). Escaped from cultivation, but not before recorded as well naturalized" (*sub Spiraea sorbifolia*). Three years later, Prof. James Fowler (1901a, 1901b) reported this shrub from St. Andrews, N.B. ". . . probably mark the sites of former gardens" (*sub Spiraea sorbifolia*). Again James Macoun (1906) reported it "Escaped from cultivation and well naturalized on the bank of the Gatineau River at the railway station, Wakefield, Quebec, 1903. (John Macoun)" (*sub Spiraea sorbifolia*).

The first report in a regional flora of the occurrence of *Sorbaria sorbifolia* outside cultivation in northeastern North America was in the seventh edition of *Gray's Manual* (Robinson and Fernald, 1908), where the following note appeared: "Common in cultivation, and escaping to waste land and copses." However, no indication was given as to where it might be found. Britton and Brown (1913) in their *Illustrated Flora* (*sub Schizonotus sorbifolius*) stated that it was "locally spontaneous after cultivation, Ontario to New York and Maryland." Marie-Victorin (1935) gave this information: "Echappé des jardins dans le nord-est de l'Amérique. Dans le Québec, occasionnel aux environs de Montréal." More recently, Fernald (1950) stated: "Common in cult., and esc. to waste land and copses, N.B. to Pa., Ind. and Minn." but Gleason (1952) reverted to the broader distribution: "Commonly cultivated and frequently escaped along roadsides and fence-rows, especially in the e. states and e. Canada."

Recent local lists have recorded *Sorbaria sorbifolia* from several areas in Canada: Prince Edward Island (Erskine, 1961); New Brunswick (Hagmeier, 1959); Marmora District, Ontario (Gillett, 1954); Norfolk Co., Ontario (Landon, 1960); southern Ontario (Soper, 1949); Ontario (Montgomery, 1957); and Saskatchewan (Russell, 1954; Breitung, 1957).

The Saskatchewan record is based on a specimen from Clearwater Lake, *J. B. Campbell, s.n.*, June 5, 1940 (DAS, Photo DAO). Campbell *in lit.* has reported the following: "My feeling at the time of collection, and particularly

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after I identified the material, was that at least one plant had been planted. However other plants were growing at the site, and I assumed that some of these were from natural seedlings. Recent development at Clearwater Lake will have destroyed the stand. Thus my memory suggests that the plants at the site were introduced by planting." *S. sorbifolia* should therefore not be considered a part of the flora of Saskatchewan.

In the present study, specimens have been examined in the herbarium of the Canada Department of Agriculture, Ottawa (DAO), the herbarium of the National Museum, Ottawa (CAN) and Queen's University Herbarium, Kingston (QUK). In addition, records have been obtained from the curators of herbaria at the University of Toronto (TRT) and Ontario Agricultural College, Guelph (OAC). On the basis of these records, *S. sorbifolia* is now known to occur outside cultivation in six Canadian provinces: Nova Scotia, Prince Edward Island, New Brunswick, Quebec, Ontario and Alberta. The records are as follows:

NOVA SCOTIA: ANNAPOLIS CO.: roadside, Tupperville, H. Groh, s.n., July 26, 1928 (DAO); LUNENBURG CO.: a few shrubs growing on railway embankment by overhead railway bridge near Stanford's Lake, Chester, *M. N. Zinck, 381,* July 16, 1938 (DAO); VICTORIA CO.: along roadsides, escaped from cultivation, Baddeck, Cape Breton Island, *J. Macoun, 19,070,* July 22, 1898 (CAN).

PRINCE EDWARD ISLAND: QUEENS CO.: escaped to roadside and doing well, Bonshaw, *Erskine & Dore, 1125,* July 1, 1952 (DAO).

NEW BRUNSWICK: CHARLOTTE CO.: thicket near dwelling, St. Stephen, *H. J. Scoggan, 12521,* July 18, 1955 (CAN); St. Andrews, *J. Fowler, s.n.,* July 9, 1900, and July 11, 1900 (QUK): KINGS CO.: thicket, Hampton, about 25 miles northeast of St. John, *H. J. Scoggan, 12377,* July 12, 1955 (CAN); RESTIGOUCHE CO.: Dalhousie, *M. O. Malte, 877,* Aug. 10, 1926 (CAN); KENT CO.: or WESTMORLAND CO.: St. Joseph, *Rev. J. Fiset, s.n.,* July 1919 (DAO).

QUEBEC: GASPÉ CO.: Gaspé Basin [cult?] *J. Fowler, s.n.,* July 28, 1905 (QUK); GATINEAU CO.: between the Gatineau River and M. Gamble's, Wakefield, *J. Macoun, s.n.,* July 13, 1903 (TRT); well established on the bank of the Gatineau River, Wakefield, *J. Macoun, 59934,* July 18, 1903, (CAN); HUNTINGDON CO.: a small patch, 3 miles east of Huntingdon, *Bassett & Hamel, 2619,* Aug. 19, 1952 (DAO); STANSTEAD CO.: pâturage sur vieux jardin, Massawippi, *Marie-Victorin et al., 2010,* 1 juillet, 1943 (CAN); roadside three miles south of East Hatley, *Frankton & Bassett, 1796,* Aug. 11, 1961 (DAO); VAUDREUIL CO.: Rigaud, *Roy, 3263,* 14 juillet, 1934 (DAO); same place, *Roy, 3789,* 16 juillet, 1935 (CAN, DAO); bord de la route, St.Rédempteur, *Cinq-Mars & Gagnon, s.n.,* 4 août, 1945 (DAO).

ONTARIO: ALGOMA DIST.: a few plants in the area near railway tracks, sandy soil, Blind River, *Bassett & Bragg, 3125,* July 9, 1954 (DAO); near sheds of Railway Station, Blind River, *Montgomery & Shumovich, 1252,* Aug. 10, 1952 (OAC, TRT); CARLETON CO.: edge of swamp, probably escaped, Arboretum, C. E. F., Ottawa, *R. M. Horner, s.n.,* July 26, 1947 (DAO); near side road and abandoned house site close to deciduous woods, well established shrubs to 6 ft. tall, probably cultivated at one time, just south of Dow's Swamp and west of C.P.R. track, Ottawa, *L. Jenkins, 5765,* June 23, 1955 (DAO); rank-growing 6 ft. shrubs cultivated along roadside ditch and spreading into ditch,

Carlsbad Springs, *Cody & VanRens, 11190*, July 7, 1960 (flowering) and *11234*, Aug. 18, 1960 (fruiting) (DAO); roadside by deserted house, Carlsbad Springs, *W. H. Harrington, s.n.*, July 8, 1906 (CAN); Carlsbad Springs, *J. Macoun, 85519*, Sept. 4, 1911 (CAN); Beechwood, Ottawa, *J. Macoun, 85520*, June 29, 1911 (CAN); HALIBURTON DIST.: roadside near edge of woods 4½ mi. S.W. of Wilberforce, *Senn et al., 5118*, July 23, 1949 (DAO); HASTINGS CO.: escape in pasture on fixed sand dunes 2 miles northwest of Cordova Mines, *J. M. Gillett, 6512*, July 12, 1952 (DAO); LEEDS CO.: shrubs 2 m tall, forms a thicket in a pasture, Delta, Highway 42, *R. E. Beschel, 10561*, June 23, 1960 (QUK); MUSKOKA DIST.: West Gravenhurst, *H. Groh, s.n.*, Sept. 2, 1936 (DAO); NORFOLK CO.: Woodhouse Twp., Lot 12, Gore, *M. Landon, s.n.*, Aug. 8, 1952 (OAC); ONTARIO CO.: dense stand on sandy roadside near Erskine Cemetery, Dunbarton, *Shumovich, 40*, July 19, 1952 (OAC); PRESCOTT CO.: rank-growing shrub to 4 ft. in height forming a dense stand 50 x 20 ft. in sand of old clearing, spreading by underground roots, shorter sterile plants on periphery, 4 miles northwest of Pendleton, *Cody & VanRens, 11199*, July 7, 1960 (flowering) and *11235*, Aug. 18, 1960 (fruiting) (DAO); bord d'une ancienne voie ferrée près d'un jardin, inconnu ailleur dans la région, Hawkesbury, *R. Hainault, 134*, July 20, 1953 (QUK); roadside and in partial shade in moist open woods, Clarence, *W. J. Cody, 11182*, June 29, 1960 (DAO); THUNDER BAY DIST.: Nipigon, *H. Groh, 73*, July 10, 1939 (DAO).

ALBERTA: roadside, Peace River, *H. Groh, 1022*, Sept. 16, 1939 (DAO).

Although *S. sorbifolia* was first collected in Canada at Baddeck in Nova Scotia by John Macoun in 1898, and reported from there in the same year by his son James Macoun, it escaped the notice of Dr. Roland (1947) when he wrote the flora of that province. The Erskine & Dore specimen cited here from Bonshaw, Prince Edward Island, is the basis for the only record in Erskine's (1961) flora of that province. The basis for the New Brunswick occurrence given in the eighth edition of *Gray's Manual* (Fernald, 1950) is probably Fowler's (1901a, 1901b) report from St. Andrews, but there may also be either a Fowler or a Malte specimen preserved in Gray Herbarium. In his list of New Brunswick plants Hagmeier (1959) probably included *S. sorbifolia* on the basis of the report in *Gray's Manual*. The Ontario report given in Britton and Brown (1913) may possibly be based on a duplicate specimen at New York Botanical Garden collected at Carlsbad Springs or Beechwood by John Macoun. *S. sorbifolia* may have been included in Soper's (1949) list for southern Ontario on the basis of the report in Britton and Brown (1913) or the Groh collection from West Gravenhurst, although this latter collection is from within the Canadian Shield and thus north of the area treated by Soper. It is now known to occur outside cultivation in 11 districts and counties in Ontario. The records from Gatineau, Huntingdon, Stanstead and Vaudreuil counties in Quebec indicate that this species is not restricted to the Montreal region, as recorded by Marie-Victorin (1935). As previously mentioned, the species was first recorded from Quebec, from Wakefield, in Gatineau County, by James Macoun (1906). *S. sorbifolia* can now be recorded as new to the flora of Alberta and deleted from the flora of Saskatchewan.

It will be interesting to follow the extent of spread of this species, particularly in eastern Canada.

Thanks are hereby extended to Prof. F. H. Montgomery, Department of Botany, Ontario Agricultural College, and to Dr. J. H. Soper, Department of Botany, University of Toronto, who kindly furnished the records of *Sorbaria sorbifolia* from their respective herbaria and to Dr. R. Beschel for the loan of specimens from Queen's University, Kingston.

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NOTICE TO CONTRIBUTORS

The editor will be absent from Ottawa on field work from April 16 to July 20. Manuscripts should still be addressed to him at Ottawa during this period but a delay in their acknowledgment must be expected.

Beginning with Vol. 76 No. 3 of the CANADIAN FIELD-NATURALIST all titles of periodicals in reference matter of articles and in the text of notes should be written in full, not abbreviated.

GEOLOGY OF PART OF THE TOWNSHIPS OF MARCH, HUNTLEY AND NEPEAN, CARLETON COUNTY, ONTARIO

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Introduction

The Ottawa Sheet, as standardized in the National Topographic System, lies between latitudes 45°15′ and 45°30′ and longitudes 75°30′ and 76°00′. This area, which is partly in the Province of Quebec and partly in the province of Ontario, is underlain mostly by Palaeozoic rocks of the Ottawa-St. Lawrence lowland, but includes some Precambrian rocks of the Canadian Shield.

In that part of the sheet that is in the province of Ontario, the Shield rocks form an area of about 15 square miles. This is the eastern half of a southeasterly trending ridge of such rocks which joins the main mass of the Canadian Shield near the town of Arnprior, about 10 miles to the west.

Brief mention is made of the Precambrian rocks of the area in the geological reports by Ami (1904), Ells (1902) and Wilson (1946).

General Geology

Principal rock types are quartzite, crystalline limestone and granitic paragneisses which are deformed into a vertically plunging, S-shaped fold and intruded by stocks of granite, diorite and syenite. Northward and eastward these rocks are overlain by flat-lying Palaeozoic sandstones, but to the south they are in fault contact with Ordovician limestone (Figure 1).

METASEDIMENTARY GROUP

Quartzite. Good outcrops of banded quartz rock occur on lots 7, cons. III and IV of March tp. (in a road cut on the Trans-Canada Highway), on lots 14 and 15, con. I, Huntley tp. and in a wide band through lots 1 to 5, con. I, Nepean tp. Although massive and feldspathic varieties of this rock do occur, its sedimentary origin is indicated by the regular stratiform partings within the rock as well as by its occasional interbanding with the limestones and banded gneisses (Figure 2). In thin-section the rock was seen to consist of elliptical, interlocking grains of quartz about 3 mm in length, sutured and minutely brecciated and containing fine needles of sillimanite and rutile. Microcline and biotite, the latter broken down to muscovite and hematite, are also present.

Locations of particular outcrops in this report have been given by lot, concession and township, but space did not permit showing these on the accompanying map. Nepean township is covered only at the northeast corner of the map-area, its western boundary being the straight road which runs a little west of north and which meets the northern boundary of the map about a mile east of the title block. Concession I is south of the Trans-Canada Highway, its lots being numbered eastward from the township boundary so that lot 5 covers the intersection of the railway tracks. The southwestern corner of the map is mainly concession I of Huntley township and the lots, which are each about .4 of a mile wide, are numbered so that number 15 is southeast and number 16 is northeast of the Trans-Canada Highway which separates them. The rest of the map is March township. Concessions I to IV appear on the map, each a little less than a mile deep and numbered from the boundary with Huntley township. This boundary is the northwesterly running road a little southwest of the words "Hazeldean Fault". Lots are numbered as in Huntley township.

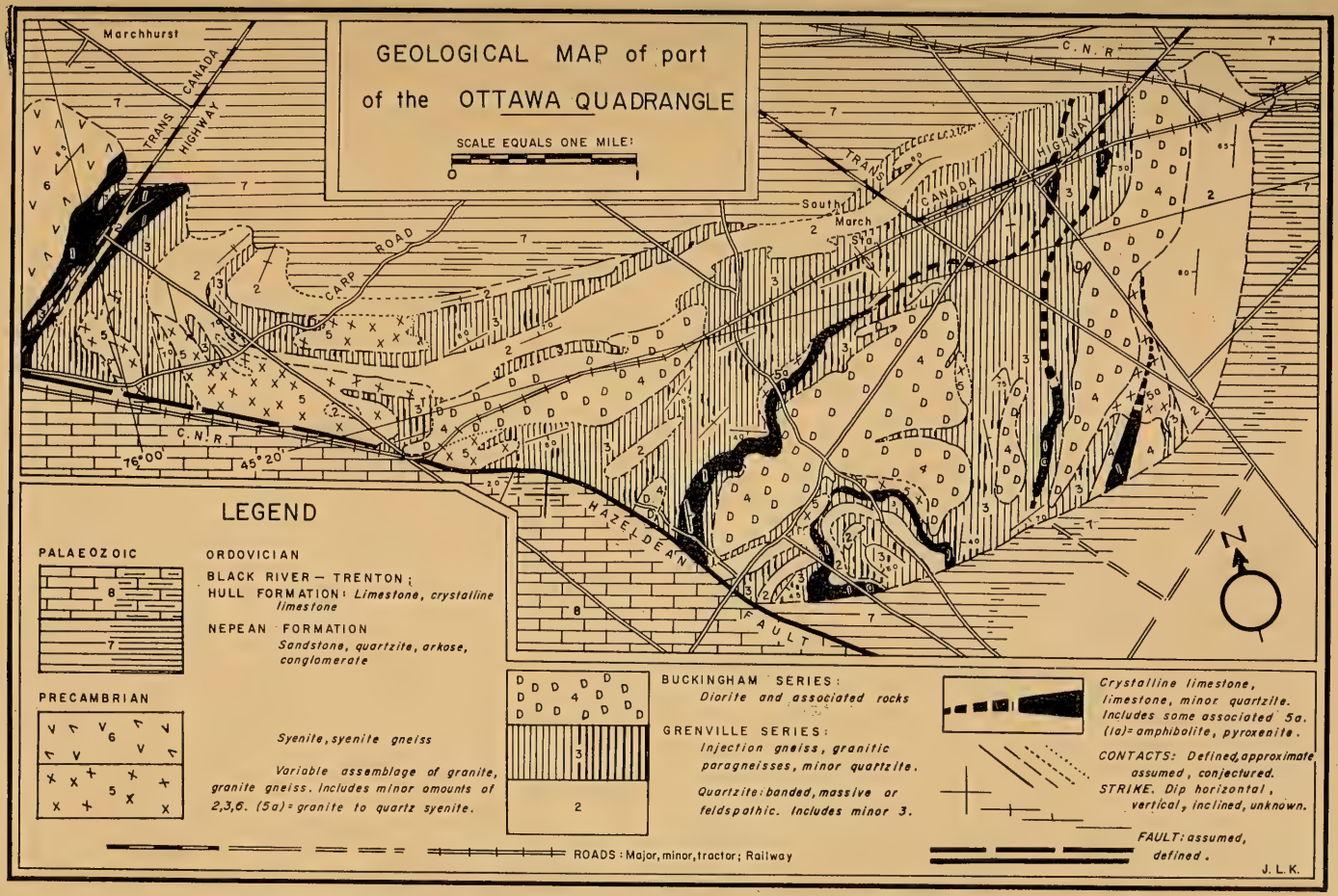
GEOLOGICAL MAP of part of the OTTAWA QUADRANGLE
SCALE EQUALS ONE MILE
Marchhurst
TRANS CANADA HIGHWAY
CARP ROAD
C.N.R.
South March
HAZELDEAN FAULT
76°00'
45°20'
LEGEND
PALAEOZOIC
ORDOVICIAN
BLACK RIVER — TRENTON; HULL FORMATION: Limestone, crystalline limestone
NEPEAN FORMATION
Sandstone, quartzite, arkose, conglomerate
PRECAMBRIAN
Syenite, syenite gneiss
Variable assemblage of granite, granite gneiss. Includes minor amounts of 2,3,6. (5a) = granite to quartz syenite.
BUCKINGHAM SERIES:
Diorite and associated rocks
GRENVILLE SERIES:
Injection gneiss, granitic paragneisses, minor quartzite.
Quartzite: banded, massive or feldspathic. Includes minor 3.
Crystalline limestone, limestone, minor quartzite. Includes some associated 5a. (1a) = amphibolite, pyroxenite.
CONTACTS: Defined, approximate assumed, conjectured.
STRIKE. Dip horizontal, vertical, inclined, unknown.
FAULT: assumed, defined.
ROADS: Major, minor, tractor; Railway
J. L. K.

FIGURE 1. Map showing the distribution of major Precambrian rock types at the west edge of the Ottawa sheet.

Sometimes, both across and along strike, the feldspar content of these quartzites increases so that the rock has a composition approaching that of granite. For this reason, and because quartzites and granite gneisses are often interbanded, contacts between the two rock types are somewhat arbitrary. On the accompanying map, the term "quartzite" refers to those rocks in which quartz predominates over all other minerals and which form more than half of the outcrop.

Crystalline Limestone. Bands of crystalline carbonate rock were found particularly useful for outlining geological structure in the map-area because they form marker horizons which are easily traced in the field. The bands typically consist of grey-weathering medium- to coarse-grained calcite euhedra and often have biotite, quartz, apatite, hornblende and other minor constituents aligned so as to give the rock a stratified appearance (Figure 3). Other types include a massive cryptocrystalline grey and purple variety which outcrops on lot 15, con. I, Huntley tp. and a medium-grained pink crystalline variety which occurs interbanded with white quartzite on lot 2, con. I, Nepean tp.

A prominent feature of the limestones is their association with white, coarse-grained granite; whenever the white granite occurs it indicates the presence of carbonate rock nearby. Often the granitic material appears as spheroids 2 to 10 inches in diameter imbedded in the limestone (such as on lots 5 and 7, con. II, March tp.), otherwise the granite is massive and has a gradational contact with the carbonate. A thin-section from the white granite was composed of microcline feldspar, quartz, scapolite and graphite in grain sizes from 0.1 to 10 mm in diameter.

The significance of the association of the white granite and crystalline limestone is not known, but there is some evidence that the granitic spheroids resulted from the brecciation of granitic dykes and the rounding of the fragments by rolling in the plastic carbonate during folding.

Amphibolite, Pyroxenite, Serpentinite. A band of rock composed chiefly of hornblende and calcite, with a little serpentine, outcrops on lot 3, con. III, March tp. This amphibolite, being associated with crystalline limestone, was likely produced by metamorphism of an impure facies of the carbonate.

A grey weathering mass of dark green to black rock outcrops along the south edge of lot 4, con. II of March tp. In thin-section the rock was seen to consist of diopside, in crystals about 4 mm in diameter, with a little interstitial calcite and quartz. Field relationships show that this pyroxenite is part of a band of crystalline limestone. It probably represents the metamorphic products of a quartzose, magnesium-rich segment of the limestone.

On lot 16, con. I, March tp., serpentine-rich carbonate rocks occur. Because the outcrops are small but elongate and the serpentine is platy it seems likely that this occurrence indicates local faulting.

GNEISSIC GROUP

The banded feldspathic rocks form the commonest occurring map-unit of the area. They consist of a wide variety of rock types ranging in composi-

tion from quartz diorite to feldspathic quartzite, with granite predominating. That many of these are of sedimentary origin is suggested by their regularity of banding, their conformable association with quartzites and limestones, their confinement to definite stratigraphic layers and, occasionally, a mineralogy suggestive of altered pelitic sediments. Drag-folds, boudinage and questionable crossbedding are also present.

Several types are noted, but not differentiated on the accompanying geological map. *Hornblende gneiss* is composed of medium-grained perthitic feldspar, green hornblende, quartz and some biotite and crops out chiefly in the western part of the area. *Biotite gneiss* is virtually the same, except that biotite predominates over hornblende. *Dioritic gneiss* is a term applied to banded rocks having a composition and appearance similar to the intrusive diorites of the area and which usually outcrop near such bodies. *Rusty weathering gneiss* describes a fissile arrangement of quartz, mica and potassium feldspar, with pyrite and magnetite, the weathering out of which stains the outcrop a rusty brown. One or two small outcrops of this rock type were observed on lots 4 and 5, cons. II and III, March tp. *Garnet gneiss* is a distinctive rock type which contains abundant red garnets segregated into irregular bands, the garnets usually being arranged into a series of ellipses about 2 inches in diameter. Outcrops of this rock are common on lots 6 and 7, con. III, March tp., a thin-section from the latter showing garnet, abundant biotite, antiperthitic feldspar and quartz.

In virtually every outcrop of the banded gneisses, lenses and layers of granitic material which show crosscutting and other intrusive relationships with the gneisses appear. When the intrusive material was prominent in the outcrop- such as on lot 5, con. II, March tp. – the rock was termed *injection gneiss*.

As with the boundary of the gneisses with the quartzites, the boundary of the gneisses with the intrusives is poorly defined. An attempt was made to restrict the banded rocks to the gneissic group (to include as many paragneisses as possible) and massive rocks, including those having truly gneissic texture, to the intrusive group (to exclude as many paragneisses as possible). Nevertheless, when banded rocks become truly gneissic along strike – such as on lots 10, 11 and 12, con. I, March tp. – contacts are necessarily somewhat arbitrary.

INTRUSIVE GROUP

Diorite and Allied Rocks. Several bodies of massive, or occasionally gneissic, crystalline rock with a medium grey weathered surface and dark grey to dark greenish grey fresh surface outcrop within the map-area. These bodies consist of fine- to medium-grained assemblages of andesine, augite and biotite with hornblende, diopside, quartz, scapolite or calcite sometimes present. Sphene and iron ores are characteristic. The masses are fairly variable (with sharp contacts between different phases), but generally they have the composition of a diorite. That the bodies are at least locally intrusive into the gneisses is shown

by the presence of banded xenoliths in the diorite (lot 4, con. II, March tp.) and by dykes of dioritic composition in the gneisses (lot 5, con. III, March tp.).

Granite. Massive granitic rocks are restricted to the crest of the fold appearing in the western part of the map-area and to the rims of the diorite masses. A thin-section from the granite on lot 10, con. I, March tp. taken from an outcrop about 1000 feet from massive diorite consists of about 70 percent albite (Ab_{95}-Ab_{100}), 20 percent quartz and some microcline and biotite, all showing a medium-grained granoblastic texture. This unusual composition, as well as the field association of diorite, suggests that this granite was derived from the more mafic rock. On the other hand, the massive and gneissic granite from lot 12, con. I of March tp. has a composition similar to that of the surrounding gneisses, which might indicate that it was derived from these rocks.

The granite from the edge of a diorite mass on lot 4, con. II, March tp. is interesting. Although massive, it can be traced into banded gneisses southward and is made up of minerals similar to those in the gneisses, yet it has a gradational contact with the diorite and contains minor amounts of minerals typical of the diorite, such as andesine and sphene. That this was derived from fusion of the gneisses seems apparent, the mechanism involved being either melting from the heat from the diorite during intrusion or, noting that this rock outcrops at the nose of a fold, from plastic flow of the gneisses along a pressure gradient during folding.

The Geological Survey of Canada's aeromagnetic map of the area (1950) shows distinct magnetic anomalies over some of the granitic bodies, reflecting the occurrence of disseminated magnetite present in some of these rocks.

Syenite. At the extreme west end of the area a large body of crystalline rock outcrops. This rock was termed syenite on the basis of field relationships west of the map-area, but its composition is much more variable than the name implies. Quartz-rich and highly mafic facies were noted in the field and thin-sections show some minerals typical of the diorites. Perhaps the rock represents a contaminated diorite.

Pegmatite and Aplite Dykes. Conformable and discordant veins of aplite and pegmatite are present in most of the outcrops near plutons and in dilated zones at the crests of folds. Large masses of coarse pegmatite have intruded the diorites and gneisses in many locations and feldspar quarries have been made in some. The quarries – the principal ones being on lots 3 and 6, con. II, March tp. – have all been abandoned.

PALAEOZOIC SEDIMENTS

The lowest member of the Palaeozoic sequence in the Ottawa area is the Nepean formation of A. E. Wilson (1946), the nearly flat-lying strata which unconformably overly the Grenville-type rocks of the Precambrian. Because

FIGURE 2. Well-banded quartzite interbanded with injected diorite and granitic rocks and cut by pegmatite dykes. Location is just southeast of the main diorite mass in the area.

FIGURE 3. Crystalline limestone west of the Trans-Canada Highway, showing well-developed stratiform banding.

of the virtual absence of fossils in the clastic rocks which comprise the formation. there is uncertainty as to whether the formation is Cambrian or Ordovician.

Conglomerates are relatively rare and poorly exposed. They occur on lots 14 and 15, con. I, March tp. and a few feet south of the intersection of the railway tracks at the east end of the map-area. The first mentioned is an assemblage of rounded quartz pebbles which range in size from sand grains to about 18 inches and whose occurrence defines part of the northern boundary of the Precambrian. The second is composed of quartz pebbles about one inch in diameter in an arkose matrix which overlies the Precambrian but whose total area is only about three square feet. The third is an assemblage of subangular quartz pebbles about one inch in diameter held in a matrix of feldspathic quartz sandstone outcropping within 20 feet of Precambrian quartzite. Uniform, cream coloured or white strata of orthoquartzite are common in the area and may be observed on lots 2, 3, 10 and 11, con. II, March tp. and in cliff facings along the eastern margins of the map-area.

On lot 9, con. I, March tp., a small hill of bedded, medium- to coarsely-grained crystalline limestone containing abundant broken fossil shells, and dipping about 20 degrees to the northwest, outcrops. On the same lot and on the adjoining lot 8, horizontal strata of normal, microcrystalline, fossiliferous grey limestone outcrops to form a small hill about 200 feet long. Specimens from these two outcrops were dated by A. E. Wilson of the Geological Survey of Canada (personal communication) as belonging to the Hull member of the Ottawa formation, Trenton group of the Middle Ordovician.

CENOZOIC DEPOSITS

Unconsolidated glacial and lacustrine deposits, consisting of sand, gravel, clay and silt occur throughout the area and reach their greatest development eastward and southward. They are described in detail in the memoir by Johnston (1917) so are not elaborated upon here.

STRUCTURAL GEOLOGY

The accompanying geological map of the area (Figure 1) shows that the rocks have been deformed into a nearby S-shaped fold which plunges nearly vertically. Evidence of folding is found in individual outcrops as drag-folds, boudinage, slickensides between beds and, on lot 5, con. III, March tp., the nose of a fold. Unfortunately, top determinations could not be made with certainty.

In the Precambrian rocks, minor faulting occurs in almost every outcrop, but no major displacements were detected. The post-Ordovician Hazeldean fault, which defines the southern edge of the Precambrian in the area is demonstrated by the tilted beds of Hull limestone. These outcrop within 200 feet of the Precambrian rocks but are at a lower elevation. This location is on strike of the Hazeldean fault defined by Wilson (1946) a few miles to the

TABLE 1. — FORMATIONS

CENOZOIC	PLEISTOCENE and RECENT	Sand, Gravel, Clay, Silt
	Unconformity	
PALAEOZOIC	ORDOVICIAN: Trenton Group *Ottawa Formation*	*Hull Member*: Crystalline Limestone
	CAMBRIAN *or* ORDOVICIAN *Nepean Formation*	Orthoquartzite, Arkose, Conglomerate
	Unconformity	
PRECAMBRIAN	Intrusive Group	Pegmatite and Aplite Dykes Syenite Granite Diorite and Allied Rocks
	Gneissic Group	Injection Gneiss Granitic Paragneisses Garnet Gneiss Rusty Weathering Gneiss Dioritic Gneiss Biotite Gneiss Hornblende Gneiss
	Metasedimentary Group	Serpentinite Pyroxenite Amphibolite Crystalline Limestone Quartzite

southeast, so must be a continuation of it. Total displacement is not known with accuracy because of the uncertainty associated with the thicknesses of some of the sedimentary formations, but from the figures contained in Wilson's memoir (1946) a vertical displacement of over 700 feet is calculated.

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REVIEWS

Birds of the Caribbean

By ROBERT PORTER ALLEN. New York, Viking Press; Toronto, Macmillan, 1961. 256 p., 98 colored plates. $17.50.

This handsome volume is a popular introduction to the rich avifauna of the Caribbean region. Its geographic scope includes the Caribbean Sea and its islands, coastal Central America from the Yucatan Peninsula south to Panama and coastal South America from Panama east to about Trinidad.

The approximately 1000 species of birds found in the region are represented in the book by 98 species of 50 families. All 98 species are beautifully illustrated by color photographs, mostly of outstanding quality, and are the work of 23 photographers. Many cover a full page, several two pages, and show excellent detail. The book is built around available high-quality photographs which from that region are limited in number. Yet this reviewer has seen only two or three of the photographs reproduced elsewhere (Saffron Finch, Glossy Cowbird, Barn Owl). Unfortunately, plates 66 and 68 appear to be missidentified and should be captioned *Pyroderus scutatus* and *Rupicola peruviana* respectively (Wetmore, 1962, Atlantic Nat. 17:60).

The species accounts, in popular vein, are informally informative, occasionally narrative, and contain many well-chosen quotes and much other documented information from various sources. There is also an Identification Guide (pp. 207-242) giving descriptions, ranges in considerable detail, and a compilation of additional vernacular names. A short chapter (pp. 243-248) contains the names of the photographers, a few biographical details and for camera enthusiasts data on equipment (camera, lenses, film) and techniques used for particular photographs. An introductory chapter outlines the region and discusses the origin and distribution of the avifauna. Finally, there is a useful 5-page bibliography.

The book is aimed at the layman and jet-age traveler to the Caribbean and makes no pretenses of being an exhaustive treatise or a complete field guide to all the birds of this rich region. For those who want to continue further, however, it contains plenty of suggestions. From its attractive jacket depicting a Blue-gray Tanager through its multicolored pages, superb photographs, and lively writing it is a beautiful book that will be enjoyed by just about anybody.

W. EARL GODFREY

The Cloud Forest

By PETER MATTHIESSEN. New York, The Viking Press, 1961. 280 p. $7.75.

The title of this book leads one to expect an ecological work, but in fact it is a wonderfully told chronicle of a journey which begins in New York and continues to Perú by way of the Caribbean Sea and the Brazilian ports along the Amazon River, to Tierra del Fuego and Mato Grosso, ending with a journey on little-known jungle rivers in Perú.

In his 20,000 mile expedition to South America, Matthiessen observes the land, the people, their customs and the wildlife. He has captured the somber character of the American indian and pictures well the quasi-modern, historic aspects of the larger South American cities. His perceptions of the silent, mysterious Amazonian jungle and descriptions of wildlife, particularly the conspicuous and easily observed insects and birds, are vivid experiences for the reader.

The region traversed is fantastically large, but the author is a keen observer, realistically noting what others before him have not, and he has succeeded in picturing the paradoxical nature of the

continent, particularly the abundance of nature, yet the danger of extinction of many species and the need for conservation. Interference with the balance of nature is tending to cause extinction of wildlife in Patagonia as it did in North America. Seals and sea otters, once common, are now scarce on the coasts of Tierra del Fuego, and the senseless persecution of the red fox of this region has resulted in an excess of geese. Full protection of many species and control of others will be needed if wildlife in South America does not follow the fate of its North American brethren.

The book is divided into two sections. The first is a travelogue of the Amazonas, the Andes, Tierra del Fuego and Mato Grosso, with brief notes on the cities visited. The second, the most interesting to this reviewer, is the chronicle of a dangerous river trip in the jungles of Perú in search of a large fossil reptile and rumored Inca ruins. Four maps and 43 of the author's photographs illustrate the text, which has only a few typographical errors.

Perhaps while reading the book one is left with the sensation that the terrain covered was done too rapidly and the experiences described were too vivid to leave lasting impressions. Segments of the travalogue, if elaborated, would make interesting books in themselves. It is hoped that other books will come from this author, particularly detailed accounts of the indians of Goiás or about the varied land of Tierra del Fuego. As stated by Matthiessen, "One must hurry if one is to glimpse the earth's last wild terrain," and this excellent book is highly recommended for those who enjoy the experience of adventure mixed with a well-written account of the vast latin land to the south.

J. R. TAMSITT
University of the Andes
Bogota, Colombia

Fishes of the Pacific Coast of Canada

By W. A. CLEMENS and G. V. WILBY. Ottawa, Queen's Printer, Second Edition, 1961. 433 p. 281 fig. $5.00 (Fisheries Research Board of Canada Bull. *68*).

Fishes of the Pacific Coast of Canada has long been the finest handbook on a North American fish fauna. It now appears in a considerably improved second edition.

The new edition is embellished with six new color plates and new type face in the keys and bibliography. Twenty-nine species, three families and 75 pages have been added. The characters in the keys have been improved and the page of the species description has been placed after each species in the key. This facilitates turning to the description. The classification has been modified. Most common names are brought into agreement with the AFS-ASIH list. The bibliography, although enlarged, is not complete; perhaps this should have been stated. As in past printings the volume presents keys, illustrations, descriptions, distributions and notes on the habits of each of the species, a history, glossary and bibliography. A map of the coast might be useful.

The ranges given include only the west coast of North America, although some species are found elsewhere. This may be misleading to the uninitiated. Although it is reported that the 1908-1909 collections of Messrs. C. H. Young and W. Spreadborough are in the U.S. National Museum, a good portion of these are actually in the National Museum of Canada. (Despite an age of over half a century they are still in fine condition). According to Svetovidov who revised their respective families, *Gadus macrocephalus* and *Clupea pallasii* are subspecies of the Atlantic forms.

The attitude of the authors towards potential records is to be much commended—"The authors have not attempted to anticipate records, in the hope that

the pleasure of discovery will be an incentive to persons and organizations to make collections throughout the extensive waters along the coast." It is to be hoped that other authors will emulate this attitude.

It may be noted that a similar work is in preparation on the fishes of the Atlantic coast of Canada and for a later date on the fishes of the Arctic coast of Canada. It is to be wished only that similar works be written on Canadian fauna other than fish.

This elegantly green cloth bound book with gold lettering is to be heartily recommended to all interested in fishing, sport or commercial, or in ichthyology. The price of only $5.00 makes it a well worth while purchase, even to those who have an earlier printing.

D. E. McALLISTER
Curator of Fishes
National Museum of Canada

Michigan Wildflowers

By HELEN V. SMITH. Cranbrook Institute of Science Bulletin 42, Bloomfield Hills, 1962 (dated 1961). xii + 465 p. $5.00.

As cities expand, wild habitats shrink; as more people have more leisure time to appreciate Nature, Nature becomes more elusive. Sensing the situation, conservation groups in Michigan have become active, the State has passed a law to protect certain rare plants, and the Cranbrook Institute has admirably provided reliable botanical information to satisfy an interested public.

Cranbrook's publication No. 42 has been expertly constructed by Dr. Helen Smith, a dedicated naturalist as well as professional botanist, into a manual of no uncertain significance describing all the wildflowers of the State. About its only difference from a strictly technical manual is the elimination of some non-essential details and addition of brief notes on the lore, soil preferences and garden potentialities of the plants. Michigan's corps of critical botanists has made sure the facts are straight. One will need to have some previous training in botany to use the book properly. And this being the case, one wonders why its use has not been facilitated by setting the keys in the now-standard progressively indented style. The page space that publishers seem to think is saved by tabulating the statements is far outweighed by the difference made between running a key and running a maze.

The drawings, too, are by a competent botanist, the well-known illustrator Ruth Powell Brede. Her plates occupy more than half the total pages. Many owners of the book will undoubtedly be tempted to color in the neat line-drawings to match their finds, a practice perhaps more popular with naturalists in the past, but still gratifying.

The manual has been kept within bounds by restricting its content to the quarter of the State's plant species which have some flower-appeal, whether native or naturalized. Ferns, grasses, shrubs, waterweeds and the like are excluded — but there are other books on these. Michigan has a considerable diversity of floristic elements related to both the deciduous and coniferous forest as well as to the prairie and Great Lakes communities. The book could therefore be of equal use in Canada from southern Manitoba to southern Quebec, and Canadian users will be satisfied to note that the Canada Thistle, for once, is designated as not coming from Canada.

W. G. DORE

Island of the Lost

By PAUL FENIMORE COOPER. New York, Putnam's Sons, 1961. 256 p. $4.95.

This is a book about King William Island and its ". . . unique role in the history of the (Canadian) Arctic". The story is accompanied by helpful charts, is beautifully told, and is a generally true enough tale. To readers particularly interested to know the truth of the Franklin

tragedy, but who have not the time to look into the records for themselves, I'd specially recommend it along with Dr. L. H. Neatby's *In Quest of the Northwest Passage.*

However, there are a few details here and there which, although they don't much affect the general truth of the story, do not quite agree with my understanding of the "Kikertarmiut" part of it, as acquired from living on the island and serving its people over the course of many years.

Of the very numerous old village and house ruins scattered throughout the King William Island area there are two main types – such as at Creswell Bay of a whaling and sealing people, mainly, (Thule?) and at Malerualik of a caribou hunting, fishing and sealing people, mainly, although these overlap at many places. But there are others which seem to be different again. Tent rings, especially at the fishing places, are very numerous. Then there are the more or less recent ancestors of today's natives – of decidedly mixed types – who do not seem to have built permanent houses anywhere but lived in skin tents spring, summer and fall, and snow houses during the winter months. This might indicate a more complicated history than in Mr. Cooper's simple tale. Some of these, perhaps, archaeologists and others may dig out in time and piece together.

In my time the numbers of caribou migrating to and from the whole King William Island area fluctuated considerably – there were lean years and fat years. But I doubt if caribou were ever very numerous on the island itself because it is extremely barren with only scant and scattered grazing available. A few hundred animals gathering at such crossing places as at Simpson Strait during late summer and early fall might well give a rather false impression to passers-by, such as Schwatka, for instance. The favourite caribou hunting places of the Netsilingmiut were on the Boothia Isthmus to Murchison River area and of the Ilivillermiut round about Adelaide Peninsula and Sherman Inlet. But always, be it noted, there was a scattered residue of caribou which remained wandering around all over the area the year round. A few small whiter caribou from Victoria and Prince of Wales Islands also sometimes visited it. Again, caribou cross back and forth over the sea ice at will from island to island or island to mainland and vice versa during ten months of the year. A very early freeze-up and very late break-up can affect the movements of caribou considerably because if the ice is good enough to walk on you don't find them collecting so much at the crossing places. But truly for ten months of every year so far as it affects the movements of the people or the caribou Kikertak is not really an island.

On pages 21-22 it is stated: "At the narrowest point the caribou crossed in autumn from the island to the mainland and the Eskimos waited for them at Malerualik – the place where one follows caribou". Although caribou did, and do, cross as described, the name Malerualik has reference to the swift current there and its rough water and waves, and not to caribou.

L. A. LEARMONTH
Georgetown, Ontario

OTHER NEW TITLES

On an Unnamed Population of the Great Horned Owl. By L. L. SNYDER. Toronto, The Royal Ontario Museum, 1961. 7 p. (Life Sciences Division, Contribution No. 54)

Distribution and Abundance of Pheasants in Illinois. By FREDERICK GREELEY, RONALD F. LABISKY and STUART H. MANN. Urbana, State of Illinois, Natural History Survey Division, 1962. 16 p. Free (Biol. Notes No. 47)

NOTES

First New Brunswick Record for the Cattle Egret

ON APRIL 29th, 1961, a flock of about 20 birds came down in a field on a farm about one mile east of the St. Croix River in New Brunswick and about ten miles up river from St. Stephen. It was reported that they were attacking the family cat and the farmer's boy fired into the flock killing one of them.

Mr. Howard Moore of Fredericton calling at the farm soon afterwards heard the story and was given the dead bird which he took with him to Fredericton where it was identified as a Cattle Egret, *Bubulcus ibis*. There through his aunt, Miss Nettie Moore, it was mounted and later placed in the New Brunswick Museum.

This is the first Cattle Egret reported in New Brunswick and there seems no reason to doubt that all 20 birds were Cattle Egrets, the largest number to be reported in one flock so far to the northeast.

W. AUSTIN SQUIRES

Curator, Natural Science Dept.
New Brunswick Museum
Saint John, N.B.
14 December 1961

Fulvous Tree Duck in New Brunswick

ON NOVEMBER 4, a party of deer hunters, including Otis Green, at Middle Dam on Seal Cove Brook on Grand Manan Id. saw a flock of 21 strange ducks, later identified as *Dendrocygna bicolor*, fly in and light in the pond. They seemed exhausted and one was later shot by a hunter. This specimen will be preserved. Nine or ten were seen at Seal Cove Meadow about a mile south on November 11 and one at Big Pond half a mile west on November 12.

On November 21 near Evandale in Kings County on the St. John River Donald Cameron fired at a flock of six unfamiliar ducks and shot five of them. A week later one of these was identified by me at the New Brunswick Museum as the Fulvous Tree Duck and eventually four, three males and one female, all adults, were made into study skins. The fifth had been plucked. All were emaciated. There was no visible fat and the remaining flesh seemed shrunken. There were a few seeds, ground up vegetation and ground up insects in the stomachs.

It seems logical to suppose that the six at Evandale were a remnant of the flock of twenty-one found at Grand Manan seventeen days earlier.

It appears that the only Canadian record previous to this influx was one taken at Alberni, British Columbia, September 29, 1905 and preserved in the Provincial Museum of British Columbia.

W. AUSTIN SQUIRES

Curator, Natural Science Department
New Brunswick Museum
Saint John, N.B.
14 December 1961

Trumpeter Swans Nesting in Saskatchewan

TRUMPETER SWANS, *Olor buccinator*, were found nesting in the Cypress Hills of Alberta in 1948 by Robert Lister (Can. Field Nat. 65:157, 1951). While visiting in the Cypress Hills Provincial Park in Saskatchewan I was told of the presence of a pair of swans by Conservation Officer R. Zaff who said that they had nested in the same spot for at least three years. Following his directions on June 20, 1961, I found a family of trumpeter swans, and was able to photograph the parent birds with their four

young about the size of a mallard. They occupied a pond with extensive reedy margins. Although only about a mile from the resort area the pond was not easily accessible and the presence of the swans was not generally known. Mr. Zaff informed me also of the presence of another pair of nesting swans in a more remote part of the Hills but I was unable to get into this area to check the report.

During the past fifteen years at least two, and possibly three, pairs of trumpeter swans have established nesting sites in the Cypress Hills and it would appear that the region has been selected as a permanent nesting area. Suitable habitat is scattered throughout the Hills but I lack a sufficient knowledge of the terrain to hazard a guess at the population of swans which might be supported. Any extension of the breeding range of such a localized species, however, is of considerable importance to its future existence.

Parts of the Cypress Hills are already set aside as provincial game sanctuaries but hunting is allowed on adjacent parts. It is to be hoped that the swans are not molested by hunters. A study of dates of arrival and departure of the swans would be of considerable value to the authorities who have the responsibility for setting the dates of the hunting seasons for legal game.

W. RAY SALT

Department of Anatomy, University of Alberta
Edmonton, Alberta
17 July 1961

Poison Sumac in Eastern Ontario

IT IS always well to know Poison Sumac and where it grows, even though of rare occurrence, so that contact can be avoided. A new site, near Summerstown, has now been reported by George N. Gogo of that town who apparently is immune to the toxin. Formerly no occurrences were known in Ontario east of Toronto and Muskoka some 250 miles away (see Soper & Heimburger, 100 Shrubs of Ontario, 1961). Stations in the province of Quebec are closer but still at considerable distances: Templeton, 56 miles northwest of Summerstown, and Laprairie, 60 miles east. The stands at these points, as well as others in Quebec at Sorel and Missisquoi Bay (see Raymond, Mem. Montr. Bot. Gard. 5, 1950), are quite small and apparently strictly localized; all are quite distant from the main population which extends northward to about central Vermont and New York.

The pearly clusters of fruit distinctive of the shrub are much more conspicuous in the wintertime when not hidden by the foliage of pinnately compound leaves. Mr. Gogo says that in the past he was in the habit of going on snow-shoes to gather pockets-full of the fruit to scatter for the Ruffed Grouse at a feeding station. He has now provided a fine specimen of leaves and fruiting panicles for deposit in the herbarium of the Plant Research Institute to substantiate his identification and record. The label data read: *Rhus vernix* L., Poison Sumac. LOCALITY: roughly two to two and a half miles west of Summerstown Station, Charlottenburg Township, Glengarry County, Ontario; growing south of the C.N.R. track and both north and south of the new Highway 401 which has cut through the area. HABITAT & ABUNDANCE: wet and mucky swampland; growing over a very considerable area, quite plentiful but in larger amount south of the new highway. DESCRIPTION: a shrub, fairly tall. DATE: September 20, 1961. COLLECTOR: George N. Gogo, Summerstown.

WILLIAM G. DORE

Department of Agriculture
Ottawa, Ont.
29 November 1961

Yellow-headed Blackbirds Breeding at Rainy River, Ontario

DURING THE period May 13 to June 9, 1961, male and female Yellow-headed Blackbirds, *Xanthocephalus xanthocephalus* (Bonaparte), were observed in the regions of the mouth of Rainy River and the shores of Lake of the Woods by members of a Royal Ontario Museum field party excavating an Indian mound some three miles upstream from the mouth of the river. The birds were usually observed in reed islands isolated from the mainland. The reed islands are located south of Quick Island at the northeastern end of Sable Island in Lake of the Woods, within the Inner Passage behind Sable Island leading from Quick Island to Four Mile Bay at the mouth of Rainy River, and upstream in Rainy River on both shores as far as Church Point, Wabanica Creek, Minnesota.

A minimal count of 35 males was made on a boat trip on June 7. Many of the males exhibited territoriality and singing. Only two nests were observed, but the presence of others was suspected from the behavior of a number of females. One male and one nest with four eggs were collected on this trip. These are preserved as specimens in the Royal Ontario Museum, Life Sciences Division, Department of Birds, Numbers 91628 (male skin) and 7544 (nest and eggs). The male obtained was singing near the nest, and was probably the male of the pair, the female of which was put off the nest when it was collected. The four eggs were fertile, the vitelline plexus and blood islands being well developed, as observed upon blowing.

This is the first breeding record of the Yellow-headed Blackbird in Ontario. However, previous reports of nesting and summering are as follows: One unconfirmed nesting report by John D. Jacob, game warden, at Saganagons Lake near Quetico Park, on May 14, 1931 (ROM files); one summer observation by L. Paterson at Quibell on the Canadian National Railway west of Sioux Lookout for which no date is available (L. L. Snyder, Trans. Roy. Can. Inst., 30: 84, 1953); one bird on May 24 and four birds on June 3, 1959, seen at Dryden by Mrs. Laura A. Howe; one on May 5 in the Black Sturgeon area by T. Swift; one on May 24 in Fort William by W. Zaroski and possibly another individual by A. E. Allin (J. M. Speirs, Bull. Fed. Ont. Nat. 85 (3):24, 1959), and one male specimen collected at Macdiarmid on Lake Nipigon on June 20, 1933 (L. L. Snyder, Trans. Roy. Can. Inst., 16: 266, 1928). An additional sight record of a male Yellow-headed Blackbird can be noted from Indian Reserve 35C, on the south shore at the base of the Aulneau Peninsula, Sabaskong Bay, Lake of the Woods, by the author, on May 24, 1961.

CHARLES S. CHURCHER

Department of Zoology
University of Toronto
Toronto 5, Ontario
19 June 1961

First Record of the Keeled Slug, *Milax gagates* (Drap.), in Nova Scotia*

THE FIRST OCCURRENCE of the keeled slug, *Milax gagates* (Drap.) in Nova Scotia was authenticated with the collection of a single specimen at Amherst, Nova Scotia, in early May, 1961. It was later identified by Dr. Aurele La Rocque, Department of Geology, The Ohio State University, Columbus, Ohio. The original specimen and subsequently several more were collected in the cellar of a house by R. S. Horsburgh of the Nova Scotia Department of Agriculture and Marketing. It was immediately seen to be an unfamiliar species, possibly the great slug of Europe, *Limax maximus* L. The strongly keeled back, elliptical impression on the mantle, and frequently darker colour in *M. gagates* will differentiate it from *L. maximus*. The specimens col-

lected were quite black, and between 60 and 70 mm. long when alive.

In England this species is one of three members of the genus *Milax* that are regarded as very destructive pests especially of root crops and potatoes. They are evidently largely subterranean in habit.

Milax gagates was not found during 1960 when rather intensive surveys of the slugs in fields and field margins were conducted in the vicinity of Kentville and Hall's Harbour, Kings County; Digby, Digby County; and Cow Bay, Halifax County. Nor did Ord and Watts (1950, New records for the distribution of certain land Mollusca in Nova Scotia. Proc. N.S. Inst. Sci. 22:16-35) find it in their extensive surveys. La Rocque (1953, Catalogue of the Recent Mollusca of Canada, National Museum of Canada Bulletin No. 129) gives its range in North America as California, Oregon, Washington, Idaho, Colorado, Pennsylvania, and probably British Columbia.

C. J. S. Fox

Research Station
Canada Department of Agriculture
Kentville, Nova Scotia
6 October 1961

°Contribution No. 1085, Research Station, Canada Department of Agriculture, Kentville, Nova Scotia.

An Observation of a Golden Eagle Dominating Coyotes

On September 11, 1961, the writers discovered the fresh carcass of a bull elk in the Cascade River Valley of Banff National Park.

On September 15, at a vantage point about 400 yards from the elk carcass, we watched with binoculars as a golden eagle fed on the remains and two coyotes moved about them. On three occasions one of the coyotes rushed forward and each time the eagle drove him away by advancing with a flapping of wings, and then resumed feeding. We watched for several minutes during which time the eagle maintained possession of the kill, the coyotes skulked nearby, and a raven and three magpies flew from tree to tree over it. No vocal activity of either the eagle or the coyotes could be detected from our observation point.

We returned three hours later to find the eagle still in possession of the kill. When we approached, the eagle and the coyotes departed, and the magpies moved in to pick up scraps. We found that most of the remains had been covered with a light layer of soil and debris scraped from around them, evidently the work of a bear.

Donald R. Flook
Donald C. Thomas

Canadian Wildlife Service
Edmonton, Alberta
20 October 1961

Exceptional Height for *Rhododendron lapponicum*

Unusually tall *Rhododendron lapponicum* were collected by me in June 1961 along the Yellowknife Highway, N.W.T., some 66 miles west-northwest of Yellowknife. The specimens were growing in a rich black spruce-feather moss forest. Plants 15 to 24 inches (38 - 61 cm) were frequent. The tallest plant observed was 30 inches (76 cm). In contrast, some manuals that include this species give 5 to 12 cm as its maximum height. Cody (1956, Can. Field Nat. 70: 121) comments upon the "tall stature"—15 to 18 inches (38 - 46 cm)—of certain of his specimens of *R. lapponicum*. Eighteen inches (46 cm) is recorded as the maximum authenticated height of the species by Polunin (*1959, Circumpolar Arctic Flora*), who does, however, suggest that a far greater height may be reached: "*R. lapponicum* . . . is an attractive little bush 4 - 25 (-46) (-100?) cm height."

John W. Thieret

Chicago Natural History Museum
Chicago 5, Illinois
28 September 1961

The Brassy Minnow, River Shiner and Sauger New to Alberta

WHILE STUDYING SPECIMENS at the National Museum of Canada three species of fishes were found which had not yet been recorded from Alberta. Since there are only 27 collections of Albertan fish in the National Museum and these contained three unreported fishes, further exploration of Alberta's fish fauna would probably be rewarding. These new records bring the known number for the province to 39 native species, while adjacent Saskatchewan has 52 and British Columbia has 56. Following the paper of Holt (1960, Copeia (3) 192-200), *Prosopium oregonium* may be removed from the list of Alberta fishes, as it is a synonym of *Prosopium williamsoni*.

Three specimens of the brassy minnow, *Hybognathus hankinsoni* Hubbs, were taken from a shallow pool in Lodge Creek streambed (Milk River-Missouri drainage) crossing highway 48, 31.6 miles north of Wildhorse, about 42 miles southeast of Medicine Hat, southeastern Alberta. They bear catalogue number NMC61-205. They possessed the following characters: preserved colour yellow; broad midlateral stripe fading anteriorly; dark middorsal stripe; dorsal origin anterior to pelvic base; mouth inferior, short, terminating before eye; scale radii 21; 8 dorsal rays; 7 or 8 anal rays; 37 to 38 lateral line scales; intestine long and coiled; peritoneum solid black.

Ichthyologists were puzzled to find the brassy minnow in ditches at Stave River near Vancouver, British Columbia in 1952, the closest collection to these being Montana. Because of the hiatus between collections it was surmised that the Stave River population was the result of an introduction. They were found in Summit Lake, north of Prince George, B.C. and in the upper Peace River, weakening the introduction hypothesis. The discovery of the brassy minnow in Alberta further reduces the hiatus between British Columbia and Montana populations.

Along with *Hybognathus hankinsoni*, were collected *Castostomus commersonii*, *Pimephales promelas*, *Chrosomus eos*, *Rhinichthys cataractae*, *Couesius plumbeus*, and *Eucalia inconstans*. Also collected with these were unusual specimens of the Iowa darter, *Etheostoma exile* (Girard). These darter specimens had few or no scales on the operculum and none on the cheek, unlike eastern specimens examined from Saskatchewan (Assiniboine-Red drainage), Ontario, and Michigan. Simon (1951, Wyoming fishes, Bull. 4 Wyoming Game Fish Dept., p. 101) describes Wyoming specimens as cheeks naked, opercles scaled, so that they would seem to be close to Albertan material in this respect. Meristic characters of Albertan material were similar to eastern specimens. The above fishes were collected by Mr. Francis R. Cook, herpetologist of the National Museum and his assistant, Mr. M. G. Foster, July 9, 1961.

The river shiner, *Notropis blennius* (Girard) is not listed for Alberta by Scott (1958, A checklist of the freshwater fishes of Canada and Alaska, Royal Ont. Mus.), although several other authors record it from there. Our specimens were collected from Morrin, in the Red Deer-South Saskatchewan drainage about 65 miles northeast of Calgary, on September 18, 1916 by George F. Sternberg. They bear catalogue number NMC58-187. Several specimens were sent to Dr. W. B. Scott of the Royal Ontario Museum. According to him (in litt.) ". . . these specimens are the first positive record we have for this species in Alberta". As the river shiner is known from Saskatchewan its occurrence in Alberta is not unexpected. The specimens have the following characters: scales, opercle and cheek silver; middorsal stripe faint but surrounding the dorsal base and not expanded at the dorsal origin; no dorsal or caudal spots; mouth almost horizontal, extending to below front of eye; dorsal origin over pelvic origin; posterior edges

of dorsal and anal slightly emarginate; pharyngeal teeth 2, 4-4, 2 or 1; dorsal rays 8; anal rays 7 and 36 to 37 lateral line scales.

The sauger, *Stizostedion canadense* (Smith) has never been recorded from Alberta. Collections NMC60-345 taken in the Red Deer River (a more exact locale was not given), June 1915 and NMC60-35 at Morrin, July 15 and 17, 1916, by George F. Sternberg, proved to be this species. The specimens are readily separable from their close relative the walleye, *Stizostedion virtreum vitreum*, also known from Alberta, by the rows of spots in the first dorsal fin, the well-scaled cheeks, the 4 to 8 pyloric caeca and the 18 rays in the second dorsal fin. One of the Morrin specimens of sauger was sent to the Royal Ontario Museum.

D. E. McALLISTER

Curator of Fishes
National Museum of Canada
Ottawa, Ontario
15 September 1961

Range Extensions of Crow-foot violet and Butterwort

FOR A NUMBER of years I have seen plants of *Viola pedatifida* on the Upper Campbell Beach near Brokenpipe Lake, about 15 miles north-west of Dauphin.

Specimens were collected in 1959, and identified at the National Museum of Canada. This site is about 75 miles north of the most northerly listing for *pedatifida* in Scoggan's *Flora of Manitoba* (1957, Bull nat. Mus. Canada 140).

The Upper Campbell was a gravel beach of glacial Lake Agassiz during one of the major periods of stability and is now followed by Manitoba highway No. 10 in this sector. Botanically it is a salient of prairie flora in the surrounding Parkland.

In 1961 numerous plants of *Pinguicula vulgaris* were found in an outlier of Boreal forest on Sec. 20-26-22 W.1, about 8 miles north of Gilbert Plains. Plants were growing on sphagnum moss on the tamarack shaded border of a spring fed pool from 2 to 6 inches above water line. Specimens and photos are filed with the National Museum. Scoggan's most southerly listing for Manitoba is Gillam, about 350 miles north of this site. This appears to be the first collection of Butterwort from the Parkland farming area.

JAMES L. PARKER

Box 99, Gilbert Plains
Manitoba
23 January 1962

A Saskatchewan Specimen of the Greater Scaup

THE OCCURRENCE of the Greater Scaup in Saskatchewan has heretofore been regarded as hypothetical (Mitchell, Can. Field-Nat. 38: 105; 1924). Recently Mr. E. M. Callin (*in litt.*) suggested to me that it would be desirable to examine an old mounted scaup from Saskatchewan listed as a Greater Scaup many years ago by Harlan I. Smith (Handbook of the Rocky Mountains Park Museum, p. 44; 1914). Fortunately the specimen is still extant in the Banff National Park Museum, Banff, Alberta, and through the courtesy of Mr. D. B. Coombs and Dr. G. M. Stirrett, National Parks Branch, I have been able to borrow it for examination. It proves to be a Greater Scaup, *Aythya marila nearctica* Stejneger, a female taken at Indian Head, Saskatchewan, in 1892 by William Spreadborough, thus establishing unquestionably the occurrence of that species in Saskatchewan.

W. EARL GODFREY

National Museum of Canada
Ottawa, Ontario
10 January 1962

RESERVE FUND FOUNDATION

Dover Publications Inc., 180 Varick Street, New York, 14, N.Y. has recently published at $1.35 a new unabridged edition of *The Common Spiders of the United States* by James H. Emerton. The original edition of this work was published by Ginn and Company in 1902 and has long been unavailable. A new key and selected bibliography by S. W. Frost, Professor Emeritus, the Pennsylvania State University, has been added.

Access to this work of the late J. H. Emerton should be of special interest to members of the Ottawa Field-Naturalists' Club, for he was a member of the club and an authority and writer on Canadian Spiders. He recorded in the CANADIAN FIELD-NATURALIST (34: 106-108, September 1920) that he had recently published a catalogue of the known spiders of Canada, 342 species, in the *Transactions of the Canadian Institute*. In the same article in the FIELD-NATURALIST, he gave an account of Canadian studies dating from 1846. One of our early members who collected for Emerton was J. B. Tyrrell: others, mostly members, whom he mentioned are E. M. Walker, T. B. Kurata, N. B. Sanson, M. Taylor, Robert Matheson, C. W. Townsend, Norman Criddle, Mrs. J. B. Faull, Charles Macnamara, F. W. Waugh, Mrs. W. W. Hippisley, A. B. Klugh, C. G. Hewitt and Arthur Gibson.

How deeply he appreciated the contacts is shown in the Report of the Council for 1931 (Can. Field Nat. 44: 19, January 1932) where Council acknowledged with deep gratitude the bequest of five hundred dollars made to the Club by the will of the late J. H. Emerton, of Boston, Massachusetts.

This was one of the early building blocks in the foundation of our Reserve Fund and as such continues to assist in the work of the Club to this day.

HOYES LLOYD

Request For Information

In making a study of the Purple Martin, *Progne subis*, I have gathered much information from my own observation and from the available literature. I now need more information on migration and population trends. I should like to complete coverage for all states in the U.S.A. and the provinces of Canada.

1. First arrival for this year and any other years you may have: date, time, summary of weather at your colony house, and to the south for the previous week.
2. Date when most or all of your birds appear to be back.
3. Date of first serious nest building activity.
4. Date when most birds finished making nests and settle down.
5. Last departed bird: date, time, summary of weather a week prior to departure.
6. Was there a peak of departure (on what date), or did birds gradually leave until the last left on the date mentioned in question No. 5.
7. Number of young fledged and left for the south per pair of parents or per colony and thus the average number of young raised per pair.
8. Any other comments, date, etc.

Anyone interested in gathering this information please write: J. C. FINLAY, 6710 - 102A Avenue, Edmonton, Alberta.

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Volume 76 JULY-SEPTEMBER 1962 Number 3

IN MEMORIUM:

RUDOLPH MARTIN ANDERSON

1876 - 1961

J. Dewey Soper

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In the death of Dr. Rudolph Martin Anderson, Canada has lost one of its most illustrious naturalists. A host of relatives, lifelong friends and colleagues mourn the passing of this dedicated and notable zoologist. It is no exaggeration to say that for those of us who were closely associated with him in various ways during the past forty or fifty years, the Canadian scene can never again be quite the same without him. He was richly gifted in the science of his choice. With outstanding skill, perception, scholarship and indefatigable energy he brought distinction to his almost innumerable accomplishments during a highly productive period of over half a century.

Dr. Anderson was born in Winneshiek County, Iowa, on June 30, 1876. He was the eldest son of John E. Anderson, B.A., M.A., LL.B. (University of Iowa) and Martha Ann Johnson, of Swedish and Norwegian descent. His mother went to Iowa from Wisconsin in 1850, settling in Winneshiek County, and his father moved from Illinois to Winnebago County, Iowa, in 1860. On January 22, 1913, Rudolph married Mae Belle Allstrand, B.A., M.A.; the union was blessed with three daughters—Dorothy Ann, Mary Lois and Isobel. For about four decades the family home was located at 58 Government Driveway, Ottawa—a familiar meeting place of warm hospitality and many pleasant memories. Dr. Anderson died there on June 21, 1961, in his eighty-fourth year and was buried in Beechwood Cemetery.

His days of schooling were crowded with studies, campus activities and academic achievements of the highest order. In retrospect, one cannot but marvel that he found time for so many and varied accomplishments. After routine public schooling he acquired his high school education at Forest City, Iowa.

From the beginning he had a passion for wildlife, forest and stream. Birds were his first love. Ever present was a consuming desire to know the different

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species, one by one, and add to his knowledge of their nesting and other habits. To this end he thought nothing of getting into the woods by daybreak to achieve his purpose before the school bell announced another day of confinement; but he took these necessary interruptions in his stride, constantly looking forward to more wildlife adventures far from class-rooms and teachers.

Consequently, through his later boyhood and early manhood, the budding naturalist lost no opportunity to roam the countryside in pursuit of the objects of his affection. At this time he learned to prepare study skins of birds and then went on to gradually build up a fine, private collection of specimens and a wealth of field notes. As the teenage years drifted by, Rudolph step by step developed into a keen and accurate observer well on his way to becoming a young ornithologist of marked ability, with dawning aspirations to publish some of the results of his original observations.

In 1893, at the early age of 17, he published his first paper entitled, *The Marsh Hawk*, and this was followed, in 1894 and 1895, by short papers on *Nesting of the Whooping Crane; The Saw-whet Owl in captivity; The Black Tern;* and *The Blue-winged Teal.* From now on his development was rapid. At the age of twenty-one he produced his most important paper, to date—*A list of the birds of Winnebago and Hancock Counties, Iowa* (1897), and ten years later the Davenport Academy of Sciences published his excellent state list, *The birds of Iowa,* which ran to a length of nearly 300 pages. Coincident with this fruition he was in steady attendance at the State University of Iowa where he earned his Ph.B. degree, in 1903, and his Ph.D., in 1906, specializing in systematic zoology, comparative anatomy and animal morphology.

For several years it appears that Anderson's major concern continued to be ornithology. In any event, after *The birds of Iowa,* he published short papers exclusively on birds in 1908 and 1909, among them, *Nesting of the Pine Siskin at Great Slave Lake; Nesting of the Bohemian waxwing* [near Fort Smith N.W.T.]; and *Breeding of Dendroica striata at Great Slave Lake, N.W.T.* His first published dealings with mammals appeared in 1913 as an addendum in Vilhjalmur Stefansson's book, "My life with the Eskimo", entitled, *Report of the natural history collections of the expedition.* This was followed shortly by *Arctic game notes;* from this time hence-forward he was chiefly preoccupied with mammals.

Concurrently, and even earlier, Anderson was on the road to prominence as an athelete with development of physique and stamina that were to prove of unique value to him in the strenuous years of Arctic activities that lay ahead. First, he trained in the cadet corps, Department of Military Science and Tactics, University of Iowa, 1897-1903, and emerged an honour graduate as cadet officer with the rank of Major. He then served with Company F, Fifty-second Infantry Volunteers in the Spanish-American War, 1898, and with Company I, Fifty-fourth Infantry, National Guard of Iowa, 1900-1906. During this period he served in all grades from Private to First Lieutenant, with several details as Battalion Adjutant; was expert rifleman with bar, 1904-1906 and Captain of the National Guard of Missouri, 1906-1908. Years later

Dr. R. M. Anderson and modified Alpine tent of his own design. Canadian Arctic Expedition 1913-16.

(1913-1916) he was in charge of vessels related to the patrol of northern waters in the Canadian Department of Naval Service.

Reverting to his years of academic training we find that Anderson was Captain of the University track team for two years and holder for several years of the Varsity record in the 120-yard high hurdles and the 220-yard low hurdles. He received the Larabee prize in zoology, 1902; the Max Mayer Cup, 1903; admitted to the Iowa Chapter of Sigma Xi, 1903; and was the first eminent archon of Iowa Betta Chapter of the Sigma Alpha Epsilon Fraternity in 1905. Both before and after graduation (1902-1906) Dr. Anderson was acting taxidermist and assistant zoologist and curator in the Iowa University Museum. It was sometime during this period of his career that he became deeply attracted to the science of mammalogy to which he contributed so much during the remainder of his life.

At about this juncture he departed from the scenes of his youth to engage in zoological field work in far-flung regions of northern North America. His first engagement of this nature was in the capacity of general field agent and assistant mammalogist of the American Museum of Natural History, New York, from 1908 to 1912; four years of this period were spent in exploratory and biological work in Arctic Alaska, Yukon Territory, and east in the Northwest Territories to Coronation Gulf, Coppermine River and Great Bear Lake. On this expedition he was the first white man to cross the Hula-hula River Pass from the Arctic Ocean to the Yukon River drainage.

Early in 1913 Anderson became a naturalized British subject. The same season he was appointed zoologist to the Geological Survey of Canada, a post that he held until 1920. In this capacity he was made Chief of the Southern Scientific Party of the renowned Canadian Arctic Expedition, 1913-1916, under the Department of Naval Service; during this highly responsible period numerous categories of scientific research were dealt with by specialists along the Arctic coast of Alaska and from the Alaska-Yukon International Boundary east to Bathurst Inlet. Upon return to Ottawa, Dr. Anderson was appointed general editor in connection with the government scientific reports of the expedition—a time-consuming and exacting task that ultimately ran to about sixteen volumes.

With the latter work disposed of, in 1920 he received a permanent appointment as Chief of the Division of Biology, National Museum of Canada; this position he held unbrokenly and with distinction until his retirement in 1948. In-so-far as pioneer field work is concerned, Anderson will doubtless be best remembered for his many years of Arctic investigations—a rugged life in which no scientific, year-round worker is apt to be confronted with more inconveniences, frustrations, handicaps and privations. These he faced with his habitual drive, aplomb and good humour, displaying the air of one revelling in the peculiar excitement attendent upon the meeting and mastering of difficulties.

However eminent his Arctic achievements, no less in another way were his accomplishments, elsewhere, in the three decades following his appointment to the National Museum of Canada. His active mind unceasingly saw many

inviting opportunities for bettering our technical understanding of Canadian mammals. As a result of this insight and the field returns that successively blossomed from them, there erupted a steady stream of published papers on the subject that far eclipsed anything previously known for the areas involved. Every summer he was off to collect data and specimens in promising territory, during which his working camps were scattered widely across the face of Canada.

Among the southern areas in which he carried out new inquiries, at this time, were parts of Cape Breton and Prince Edward Islands; New Brunswick; Gaspé Peninsula; the eastern townships of Quebec; the Gatineau Valley; Ontario; various sections of Saskatchewan and Alberta (including Wood Buffalo Park and the Rocky Mountains); and the Columbia River Valley in southern British Columbia. I particularly recall his enthusiasm at the prospect of again visiting polar lands when, in 1928, he embarked on the S.S. *Beothic* as naturalist to the Canadian Arctic Expedition, of that year, which visited western Greenland and the eastern Canadian Arctic from Ellesmere Island to Hudson Strait. With the termination of this voyage he had spent seven winters and ten summers north of the Arctic Circle.

Dr. Anderson was a lover of the wilderness, a skillful outdoorsman and a tireless collector of specimens when time and opportunity offered. As a result of his lifetime efforts the mammal and bird collections of the National Museum of Canada and other institutions were greatly enriched. Only with an abundance of specimens could he attain to those exact determinations so dear to his ideals and aspirations in systematic zoology. One may say that this was especially true in the field of mammalogy to which he devoted much the greater part of his scientific labours after 1910. In this respect his industry yielded far-reaching results. Critical examination of thousands of specimens from various large areas of Canada, led to his detection and published descriptions of numerous new geographical races. In fact, he described over 30 newly recognized subspecies represented by the seventeen genera—*Sorex*, *Blarina*, *Marmota*, *Eutamias*, *Tamiasciurus*, *Glaucomys*, *Perognathus*, *Peromyscus*, *Synaptomys*, *Clethrionomys*, *Phenacomys*, *Microtus*, *Zapus*, *Napaeozapus*, *Canis*, *Lutra* and *Phoca*. Subspecies named in his honour were: *Thomomys t. andersoni* Goldman; *Microtus m. andersoni* Rand; and *Alces a. andersoni* Peterson.

Despite constant pressures in various routine activities within and outside the museum, Anderson still found time for other responsibilities and forms of service. Over a long term of years, for example, he was consulting zoologist of the old Lands, Parks and Forest Branch, Department of Mines and Resources; a member of the Advisory Board on Wildlife Protection; also consultant on the Interdepartmental Reindeer Committee. For years he served as Chairman of the Library Committee, Bureau of Geology and Topography and the National Museum. He was also special editor on furs and fur-bearers for Webster's International Dictionary, 1935, and Associate Editor (mammalogy) of *The Canadian Field-Naturalist*, 1917-1955.

At different periods the normal, office work-day was all too short. Those of us familiar with his labours were well aware of the fact that on numerous occasions he felt obliged to work overtime, including weekends and holidays. By this means he was able to secure absolute quiet and escape interruptions imposed by administrative duties, the telephone and official correspondence; thus, often, it was possible to forge ahead on important research projects and major literary undertakings that would otherwise have come to a complete standstill. Such action accounts, in part, for the surprising output of his pen despite the multiplicity of other routine duties.

In relation to this, in a separate article, it is shown by Mr. Philip Youngman that between 1893 and 1951 Dr. Anderson published a total of 134 papers. Many of these are brief, or relatively short, and deal with a single proposition, or finding; others, again, are of considerable length, depth and complexity that demanded prolonged thought and skill in their preparation. In total there is much that is highly meritorious and valuable. Through Anderson's work a knowledge of Canadian mammals was elevated to a level previously unknown in the history of the nation. Two of his publications particularly admired by this writer are: *Methods of collecting and preserving vertebrate animals* (1932) and *Catalogue of Canadian recent mammals* (1946).

Dr. Anderson was affiliated with the following scientific societies: American Society of Mammalogists (Charter); American Ornithologists' Union; Cooper Ornithological Club; Wilson Ornithological Club; Iowa Ornithologists' Union; Pacific Northwest Bird and Mammal Society; American Society of Ichthyologists and Herpetologists; Ottawa Field-Naturalists' Club (President, 1922); Corresponding Member: Zoological Society, London; La Societe Provancher d'histoire naturelle du Canada. Honorary Member: Ornithologisches Verein zu Dresden; Arctic Institute of North America. Fellow: Royal Society of Canada; Canadian Geographical Society (Charter); Biological Society of Washington; and the American Association for the Advancement of Science. He was also active in the Professional Institute of the Civil Service of Canada.

The writing of this memorial naturally conjures up many pleasant memories. In his hey-day it was a richly stimulating experience to be associated with Anderson whether in field or study. For me, the beginning of these treasured recollections had its advent on the occasion of our first collecting trip together at Point Pelee in March, 1919; his warm friendship, quiet humour and arresting tales of the Arctic are still vividly remembered. These narratives were particularly fascinating to me, as R.M.A. was the first Arctic explorer that I had met with up to this time and he probably quite unconciously fired my ambition more than ever to become a professional naturalist-collector in the polar regions. A few years later he made this possible—a kindly act that I always valued very deeply, indeed.

My personal enjoyment of the doctor was at its best away from cities and in the heart of the great open spaces. He was invariably a boon companion of highly efficient habits on such outings and perennially keen on experimenting and generally seeking out superior methods of collecting and

preserving specimens. One could usually count on learning something new. Enthusiasm, laughter and love of wilderness life pervaded these camps.

Throughout his life Dr. Anderson was always generous with his time and attention in giving a helping hand to beginners, or coöperating with professional zoologists in the subspecific identity of newly acquired specimens, or some other particular line of research. In reflecting on Dr. Anderson's accomplishments in this country, since 1908, one feels impelled to regard him as the greatest mammalogist that Canada has ever had. His last paper, *The fur animals of arctic Alaska*, was published in 1951. For many years he had planned on producing a popular, well-illustrated book on the mammals of Canada; to this end much material was accumulated, but he could not find time to work on it before retirement and ill-health prevented him from realizing this dream thereafter.

Concerning R.M.A., an old, Arctic colleague, Dr. Diamond Jenness, wrote, in part, as follows (1961, Arctic 14(4):268) "A reserved man, rather diffident, he was never more happy than when he was sitting at the door of a tent, legs outstretched, skinning a mixed bag of shrews, marmots, sandpipers, and perhaps one or two eiders, the while keeping both ears attuned to the murmur of wind and water, and the twittering of the birds. Indians and Eskimos alike trusted and admired him, because he shared so fully their own love of nature and its wildlife . . .

"He was too individualistic, too absorbed in his own biological work, to be a forceful expedition-leader or a dynamic administrator in a museum; but he gave his subordinates every facility at his command and allowed them untrammelled freedom in carrying out their duties. In the field he was a splendid companion who cheerfully carried his share of the load and lent a helping hand whenever it was needed.

". . . I like best to remember him as the indefatigable traveller, cheerfully marching through the snow at the head of his weary dog-team in the waning twilight of an arctic day."

BIBLIOGRAPHY OF RUDOLPH MARTIN ANDERSON

PHILLIP M. YOUNGMAN
National Museum of Canada, Ottawa, Ontario

BETWEEN 1893 AND 1951 Rudolph Martin Anderson published 134 papers. These were published under the names R. M. A.; Rudolph Martin Anderson and R. M. Anderson. Each title in this bibliography has been taken from the original publication. The exact date of issue is not known for many titles, therefore, the order in which they are listed may not always be correct. Direct French translations of papers previously published in English are marked with an asterisk. Grateful acknowledgment is made to Mr. Gaston Tessier for his assistance.

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ANNUAL MEETING

The eighty-fourth annual meeting of the Ottawa Field-Naturalists' Club was held on Tuesday, December 4, 1962, at 8.15 p.m., in the auditorium of the National Museum of Canada.

MAMMALIAN DISPERSAL IN RELATION TO AN ARTIFICIAL LAND BRIDGE

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It was pointed out in a previous paper (Cameron, 1958) that Cape Breton Island lacks four species of mammals which are reasonably abundant on nearby peninsular Nova Scotia. These four, the woodchuck (*Marmota monax*), porcupine (*Erethizon dorsatum*), raccoon (*Procyon lotor*) and striped skunk (*Mephitis mephitis*), probably are absent from the Island because they reached peninsular Nova Scotia too late to take advantage of the land bridge which I believe connected the Island with the mainland in post-glacial times. I hold the view that such a land bridge must have existed because certain species of mammals, such as shrews and moles, and about fourteen species of reptiles and amphibians occur on the Island, and these species are almost invariably absent from islands where no suitable land connection has been available for mainland species to invade the island. Furthermore, the mammalian fauna of Cape Breton Island is balanced (Lack, 1944) in contrast to the disharmonic faunas of Newfoundland and Anticosti, for example. In addition to the zoological evidence, much is known about the geological history of the region which would support the view that Cape Breton Island has had a post-glacial land bridge.

Although it seems reasonable to suppose that the absence of these four mammals on Cape Breton Island is due to their late arrival in eastern Canada following the retreat of the Wisconsin ice sheet, the possibility that they may have occurred on the Island but disappeared before the arrival of the white man cannot be entirely dismissed. That this is not an improbable supposition is shown by the fact that skeletal remains of raccoons have been found in Indian kitchen middens in peninsular Nova Scotia that pre-date the first white explorers (Rand, 1943), yet the historic evidence would seem to indicate that this species first invaded the area about 1800. It is possible, therefore, that raccoons existed on Cape Breton Island prior to the arrival of the white man, but there is no archaeological or other evidence to support such a view. A number of species which do not now occur on peninsular Nova Scotia or are recent arrivals may have occurred at an earlier time, perhaps during a period of climatic amelioration such as is recorded for 5,000 B.P. (Dunbar, n.d.). On the basis of such evidence as we have, however, it seems most probable that none of the four species have ever occurred on Cape Breton, and that this absence is due to their late arrival in eastern Canada after the postulated land bridge had disappeared.

Despite the absence of a land connection which these species might have used as an immigration route to the Island, it is somewhat surprising that they did not reach it by other means. Cape Breton is separated from peninsular Nova Scotia by the mile-wide Strait of Canso and it seems likely that these mammals might have been accidently carried to the Island on floating ice or

TABLE 1—NUMBERS OF INDIVIDUALS OBSERVED AT WESTERN TERMINUS OF CAUSEWAY*

	Woodchuck	Porcupine	Raccoon	Skunk	Remarks
Numbers Observed:	21	47	41	19	Includes individuals killed on highways.
Hours of Observation:	43	63	57	52	
Distances Travelled:	211	178	127	148	On foot and by automobile; mileage recorded only for suitable habitat.

*Observations were carried out in the period one hour before sunset to two hours after and from two hours before sunrise to one hour after in the case of the porcupine, raccoon and skunk. Observations on the woodchuck were made only between sunrise and sunset.

debris. In addition, St. George's Bay, which lies just north of the Strait, freezes over each winter so that an ice bridge has been available.

In 1955 a rock causeway connecting peninsular Nova Scotia with Cape Breton Island was completed, thus providing what appears to be an excellent means for these species to cross to the Island. The causeway, which carries both a two-lane highway and a railroad, is 90 feet wide and 30 feet above high-tide mark; herbaceous plants and grasses have taken hold along the margins thus providing sparse cover for small mammals.

In an attempt to determine what species, if any, had taken advantage of this artificial land bridge, I spent two months in the summer of 1960 carrying out field studies in southern Cape Breton and eastern peninsular Nova Scotia under the sponsorship of the Redpath Museum, McGill University. The first step was to determine the relative abundance of the four species in the immediate environs of the causeway on the peninsular side. By means of direct observation, trapping and the systematic plotting of tracks and other signs, as well as from information obtained from local residents, it was determined that all four species do occur within a quarter-mile radius of the peninsular terminus of the causeway. It was found that porcupines and raccoons were common, skunks fairly common and woodchucks moderately so (see Table 1). The low density of the last-mentioned is probably due to the scarcity of suitable habitat.

Porcupines occur commonly throughout the coniferous forest belt that stretches across the eastern part of the peninsula and extends to within 300 yards of the causeway terminus. Extensive barking of trees was observed within a quarter-mile radius of the causeway and animals killed by automobiles were commonly seen on the roadways near the terminus. At least one was seen every evening between sunset and two hours afterwards.

As is evident from the observations recorded in Table 1, raccoons are common, and by some local residents considered abundant, in the area near the causeway. Their tracks were observed frequently along the margins of brooks, lakes and lagoons in the area and several were seen on the highway

where they had been killed by automobiles. Toll-keepers on the causeway informed me that they come regularly to the garbage pails at the toll-house, which is located at the peninsular terminus of the causeway. They were also frequently seen feeding along the margin of a lagoon at Auld's Cove, less than a mile from the causeway.

Skunks occur rather commonly (see Table 1) in the farming areas within three miles of the causeway and occasionally in the settlements. Local reports would seem to indicate a fairly high population, but I found that they were considerably less abundant than such reports would lead one to suppose. Nevertheless, the population is sufficiently high that there should be ample opportunity for the animals to travel on the causeway as they do on other highways.

The woodchuck population is relatively low in the immediate vicinity of the causeway terminus largely because open grasslands are much restricted. Only two active burrows were found within five miles of the causeway, although there may have been others which were overlooked.

Considering that all four species occur within a mile radius of the causeway, it is surprising that none have been reported from the causeway proper. This applies particularly to the raccoons because fish are often cast up on the causeway during heavy storms, thus providing a readily accessible source of food.

The absence of reports of porcupines on the causeway is equally surprising. These mammals make long forays along roadways and across open spaces with no apparent objective in mind; such journeys do not appear to be in search of food or denning sights because both are bypassed without any effort being made to explore them. Therefore, it might be expected that on occasion an individual would wander across the causeway. There is no substantiated report, however, of their having done so. Were such travels at all common, it is likely that there would be some highway mortality; yet, according to the toll-keepers, no carcasses have been seen on the causeway.

Skunks, likewise, might be expected to follow the causeway as they do other highways, but again no evidence could be obtained to the effect that they do so. The cast-up fish would seem to offer an attraction as in the case of the raccoons.

Because of their low density and the fact that they are not so likely to wander widely over unvegetated areas, it is perhaps less surprising that woodchucks have not crossed.

It is not considered likely that traffic on the causeway is heavy enough to act as a deterrent, since during the early morning hours, when many of the species in question are active, few vehicles use the roadway. Furthermore, none of these species is greatly disturbed by heavy traffic as the mortality figures on highways show.

Every effort was made to secure information on the occurrence of these four species on Cape Breton Island. Again, as in the case of the study on the peninsular side of the causeway, local residents were interviewed and field studies were conducted within a ten-mile radius of the causeway terminus.

No evidence for the occurrence of any of the four species could be obtained, although one report of a porcupine having been seen six miles east of Port Hastings was received by Mr. Austin Letcher, Game Warden for the southern part of the Island. He visited the locality where the animal was reported seen, but he saw neither the animal itself nor any evidence of feeding.

On Cape Breton, I carefully checked the margins of streams and lakes for the footprints of raccoons, the trees in the area for signs of barking by porcupines, and the open fields and pastures for woodchuck workings, all with negative results. Possible areas were so carefully investigated that if any individuals of these species were present, their numbers must have been very low indeed.

On the basis of the available evidence, it is possible only to conclude that none of the four species has emigrated to Cape Breton Island in sufficient numbers to become established, and furthermore that few, if any, individuals have crossed the causeway at any time. The artificial land bridge, therefore, has not served as an invasion route for these species.

DISCUSSION

In deciding whether a given island has had a land connection with another land mass, zoogeographers usually resort to indirect evidence based on the number of species occurring on the island and their ecology compared with those found on the adjacent mainland. In most cases, it can be safely assumed that there has been no suitable land bridge available to the colonizers if there is a paucity of species and the fauna is "unbalanced" (Lack, 1944). This is particularly true if amphibians and certain mammals, such as shrews, are absent from the island.

As this study has shown, however, potential colonizers may be absent from an island which has, or has had, a land connection with the mainland. The woodchuck, porcupine, raccoon and skunk have had the advantage of a land bridge between peninsular Nova Scotia and Cape Breton Island for a period of six years and, nevertheless, have failed to colonize the Island. Thus, the existence of a land bridge does not, *per se*, guarantee that colonization will take place. First of all, it is only reasonable to assume that the land connection must be ecologically favourable to potential colonizers. A connection of unvegetated sand, for example, would probably not be utilized by forest species. Secondly, it appears that conditions at the point of origin must be such as to stimulate emigration. Population pressure has been regarded by many ecologists as an important factor in animal dispersal; I concluded that the slow spread of the introduced Green Frog in Newfoundland is due to the absence of such pressure (Cameron and Tomlinson, *in press*).

It is also possible that the land connection is so narrow that potential colonizers fail to locate it. Matthews (1952) suggests this as a possible explanation for the absence in southern England of continental species that must have been present in northern France when a land bridge existed in the Straits of Dover. Here again, it may have been that the land bridge was

ecologically unfavourable and there may not have been sufficient population pressure on the continent to stimulate emigration.

In summary, this study has demonstrated that mainland species may be absent on an island despite the existence of a land bridge. Many species may not take advantage of a land connection because it is ecologically unfavourable or because conditions on the mainland are not such as to stimulate emigration.

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NOTES ON THE SKYLARK ON VANCOUVER ISLAND

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In the autumn of 1903, one hundred pairs of Skylarks (*Alauda arvensis* L.) were released near Victoria on Vancouver Island by the Natural History Society of British Columbia, and in 1913 an additional 49 birds were liberated in the same area (Carl and Guiguet, 1958). The birds increased slowly and spread northward until all suitable habitat is now occupied between the city of Victoria and the north end of the Saanich Peninsula. This constitutes the only successful introduction of the Skylark into North America (Twomey, 1936).

The Skylark is native to the British Isles and continental Europe south of the Arctic Circle, northern Africa, and central Asia, withdrawing southward in winter from northern Europe (Bent, 1942). Since it typifies the fields of England, English settlers in nostalgic mood have introduced these birds into many lands around the world. It was successfully taken to New Zealand in the nineteenth century (Oliver, 1930), where it is now a common bird on both North and South Islands. It was introduced into the Hawaiian Islands in 1865 from England and in 1870 from New Zealand (Hawaii Audubon Soc., 1959). It is now common on Hawaii and Maui, and locally so on Oahu. In Australia it has become established in suitable habitat throughout the coastal areas of the south and southeast (Cayley, 1956). In North America it has been introduced at San Jose, California; at Portland, Oregon; at Brooklyn, New York; and in British Columbia in the lower Fraser Valley and on Vancouver Island (Twomey, 1936). All North American introductions failed but the last, although they were initially successful at Portland and Brooklyn.

Vancouver Island Population

The area occupied by Skylarks on Vancouver Island is shown in Fig. 1. This has a total area of about 20,000 acres, but all of this acreage is not available to Skylarks. Small patches of forest are scattered throughout, and a complex pattern of land use on small holdings makes much land unsuitable. Less than half of the 20,000 acres is good Skylark habitat. The three areas shown isolated from the large one are recent range expansions. In the Belmont area west of Victoria a singing male was seen in 1960, and other observations have been made since. Although this area is only two miles from the nearest breeding area near Portage Inlet, it represents a move across a region of woods and rocky hills to a limited area of suitable habitat extending westward to Metchosin. Farther north, Skylarks were found singing in fields north of Mill Bay in 1961 (Davidson, 1961). Here access from the nearest occupied habitat on the Saanich Peninsula is across four miles of water. Apparently suitable habitats on islands east of the Saanich Peninsula have not been colonized, although there are unverified reports of these birds on Saltspring Island, and on August 14, 1960, a Skylark was seen near Friday Harbour, San Juan Island, the first record of the bird for Washington (Audubon Field Notes, 1961).

The habitat selected by the Vancouver Island Skylarks is rather restricted, and confined to part of an area having a climate unique in Canada. Chapman and Turner (1956) describe this climate as follows: "On the lee side of Vancouver Island and Olympic Mountains, precipitation . . . is less than 30 inches per annum over the southeastern coast of Vancouver Island. The lower annual totals are accompanied by a pronounced summer drought—July and August together receiving only 2-3 inches."

"The lee location of most of this climatic region ensures a substantial reduction of cloudiness in comparison with the west coast and a consequent increase in the number of hours of sunshine. A long frostless season coupled with mild winters and cool, but sunny summers provide temperature characteristics suitable for specialized agricultural activities, while the overall climate makes this region one of the most distinctive in Canada."

The Skylark is partial to open ground. On Vancouver Island as in Europe (Witherby, 1943; Nicholson, 1951), they frequent pastures, beaches, cultivated land, golf courses and airfields. In all cases the horizon about such places must be low to be suitable, for they avoid narrow valleys and small fields bordered by trees. The most suitable areas also have low or sparse vegetation, often with a high proportion of bare soil.

We have conducted no thorough census, but were able to count a large portion of the population in early March, 1962. The only major snowfall of the year remained on the ground for a week, covering most skylark habitat. The snow had covered most of their food, and the flocks were confined to those areas offering some kind of nourishment. Results are shown in Figure 1. During this survey we visited all areas known to have more than a few Skylarks. Birds were found in most of these areas, but it is probable that we missed some concentrations, and there are large areas known to be lightly populated in which we were unable to find birds at all. We counted a total of 694 Skylarks in three days. We therefore estimate the Vancouver Island skylark population at about 1000 birds.

Populations and Weather

Twomey (op. cit.) has shown, using climographs, that the climate of Victoria approximates that found in the Skylark's native range. This could account for its successful introduction to the Victoria region. Nevertheless, the numbers of Skylarks there have fluctuated considerably, apparently as a result of occasionally detrimental winter weather. This population appears to be resident, and therefore must survive the winters *in situ*. There is no retreat from winter like the annual migrations undertaken by Skylarks in northern Europe.

Winter weather, particularly conditions affecting the length of time the ground is covered with snow, has an important bearing on Skylark survival. For example, the winter of 1949-50 was noteworthy for its severity. In Victoria the January mean of 26.1° F, was the lowest since records began, and a temperature of 6.4°F on January 13, 1950 was a record low for the area. A total of 53 inches of snow fell during the winter and, due to cold temperatures, much of it had a long life on the ground. The ground was covered

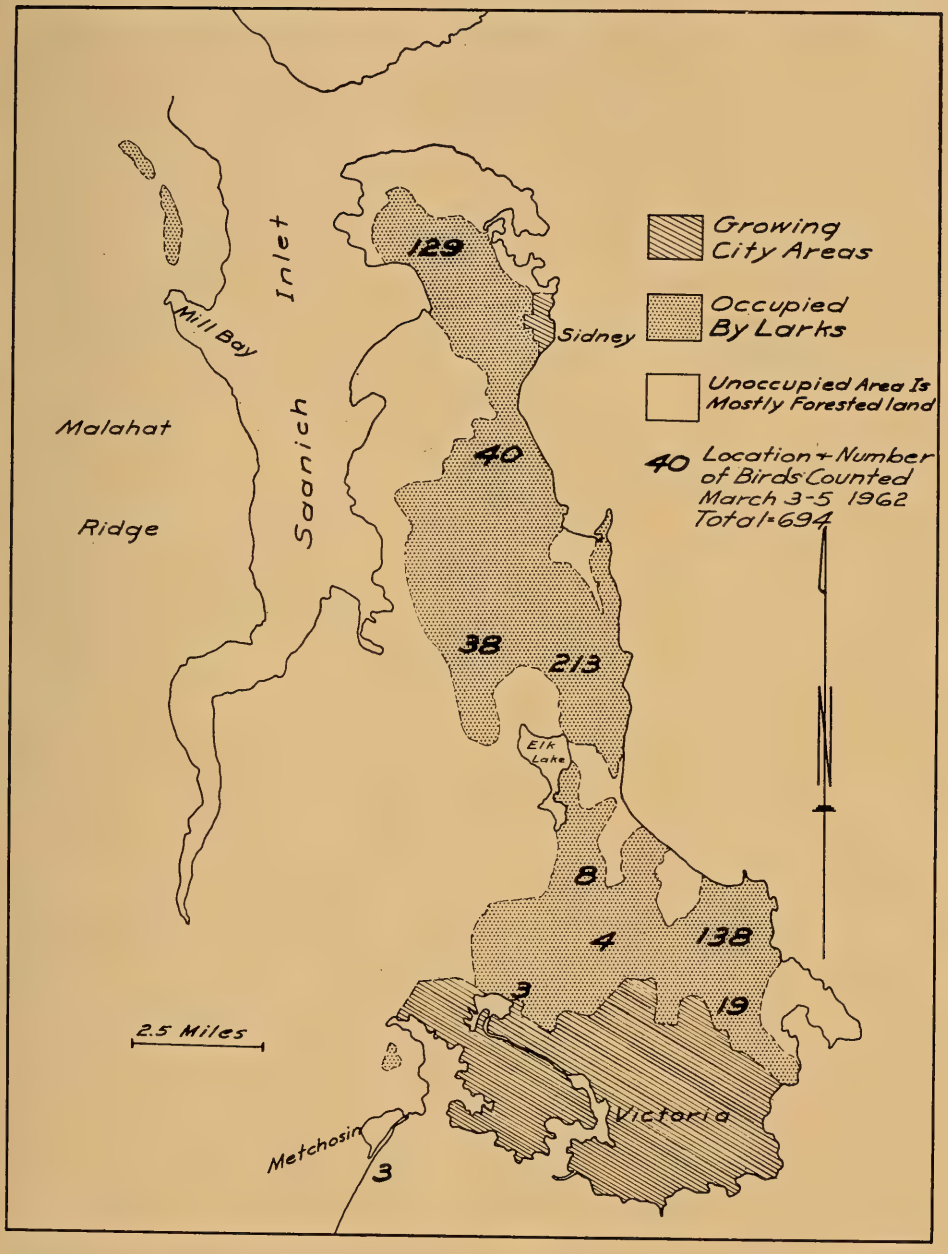

FIGURE 1. Map showing the extent of skylark distribution near Victoria, with numbers indicating the Skylarks counted during a partial census.

continuously through one period of four weeks. The following spring observers reported a general scarcity of Skylarks. Since then, winters have been generally mild with light falls of snow (Figure 2). Through this same period the population has increased, and recently has spread to new breeding areas. This increase is reflected in a general way by the number of Skylarks seen during annual Christmas bird counts (Figure 2). These counts cannot be taken as accurate censuses for all birds, but they undoubtedly do reflect major trends in population sizes for those species that are easy to find and to identify. Christmas count data in Figure 2 indicates that the population of skylarks about Victoria was very low in 1950, and after that date took six or seven breeding seasons to rise to the present population level. It is of more than passing interest here to note that the winter of 1949-50 was the last of a series of winters characterized by deep snows throughout much of British Columbia, and that in this deep snow period a number of mammals suffered high mortality. Edwards (1956) notes population declines to 1950, and increases thereafter, for deer (*Odocoileus hemionus*), moose (*Alces alces*), caribou (*Rangifer tarandus*), and several other species.

Winter Survival

Winters in the Saanich Peninsula are mainly snowless, but the year is rare that has no snow at all. In some years there may be heavy falls. In early March, 1962, several inches of heavy snow blanketed the area and persisted for a week. The Skylarks were in trouble, some groups more so than others, as shown by our observations during the last three days that snow covered the ground.

It was evident that areas known to have Skylarks still had them during this snowy period even if the available food supply was critical. Each population appeared to be sedentary to a considerable degree even under such critical conditions. On the other hand, large flocks were found in large units of Skylark range, suggesting fidelity not so much to individual territories, as fidelity to the unit of range. One flock, marked by 19 in Fig. 1, inhabits a small range surrounded by forest and suburban housing. They remained in this area, although their only food there was from a restricted area of weeds offering seeds. The food was out of reach and they were fluttering up clumsily to the seed heads in a manner indicating clearly that they were forced into an unaccustomed and inefficient manner of feeding. Another flock of Skylarks feeding in this way was accompanied by Horned Larks. The greater efficiency of the latter in obtaining weed seeds above their heads was clearly evident.

The largest flocks of Skylarks were found in cabbage and broccoli fields, daffodil fields, and weedy fields. Smaller numbers found food in barnyards, or roadside edges, bare soil along highway embankments, beaches, and under a bird feeding station. In the cabbage and broccoli fields the birds were feeding on the leaves, some of which were eaten down to skeletons, having only the major ribs. Bent (1942) mentions this type of food. We saw no evidence of damage to daffodils, the attraction here being bare soil along the sides of deep furrows.

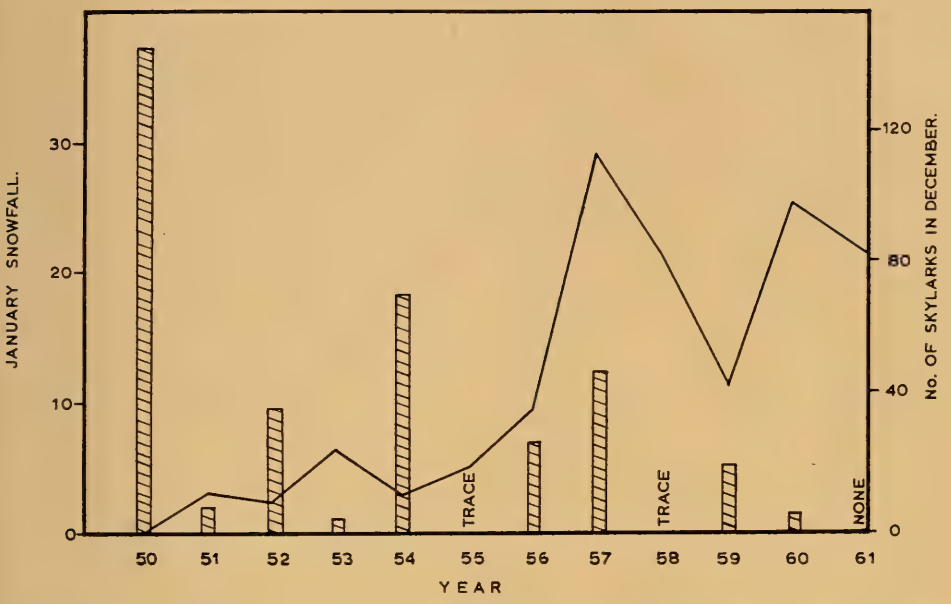

FIGURE 2. A comparison of January snowfall (hatched bars) and Skylark adundance in the following December (solid line) in the vicinity of Victoria.

Other birds were associated with the Skylarks at more productive feeding areas, the most numerous being Meadowlarks, Robins, Horned Larks, Starlings and Brewer's Blackbirds, with some Oregon Juncos, White-crowned and Golden-crowned Sparrows.

There seems to be little doubt that Skylarks, as sedentary populations, cannot inhabit areas usually covered by snow in winter, and it is probable that they cannot survive where snowfalls persist for a few weeks every year.

THE FUTURE

The Skylarks have had 60 years to expand into suitable habitat on Vancouver Island. It is reasonable to assume that they have invaded all accessible and suitable areas. Further expansion must be due to either the finding by chance of suitable areas more or less inaccessible, or to changing landscapes, mainly changes made by man, creating new suitable habitat. Some coastal lowlands on the east side of Vancouver Island, and mainly north of Nanaimo, seem to be the only large areas that might offer room for expansion.

Territory presently occupied will shrink. Victoria is an expanding city, and much of its expansion will be into areas now containing Skylarks. Suburban housing destroys Skylark habitat. A major stronghold of the species now is the municipal airport near Sidney. This should remain a stronghold for many years, unless new kinds of airports demanded by the aviation of the future results in the destruction of the present large areas of grass and herbs.

We predict that urban development creeping northward will slowly reduce the area of skylark habitat, and therefore the numbers of Skylarks.

SUMMARY

Skylarks, introduced to Vancouver Island in 1903 and 1913, inhabit a small area of less than 20,000 acres in a climatic region of low snowfall. In March, 1962, 694 Skylarks were counted and the total population is estimated to be 1000. Cold winters with persistent snow reduce the population, and brief snowy periods concentrate the birds. The growth of the city of Victoria will restrict Skylark habitat, and reduce the total population.

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FURTHER ADDITIONS TO THE BIRDS OF SIMCOE COUNTY, ONTARIO

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When the original list of birds for Simcoe County was published (Devitt, 1943, 1944) 257 bird species were recorded. To these, ten new species were added in a revision (Devitt, 1950). Similarly, the original list of breeding species was augmented by two additions (Devitt, 1950) to bring the total to 138.

The purpose of the present paper is to record further additions and changes in status of the birdlife that have occurred in the county during the past eleven years. Ten additions have been made to the list of birds previously recorded and the Mockingbird and Sandhill Crane have been elevated from their former hypothetical standing in the light of further evidence and now become added species bringing the total to 279. Definite breeding evidence for five more species now raises the number of nesting birds to 143.

A heavy mortality of small birds, mostly warblers, vireos and thrushes, occurred at the Barrie T.V. tower during the week of September 20-27, 1960. An account of the tragedy has been reported by Westman (1960). On the four nights, September 23 to 26 inclusive, 936 birds of 45 species were killed by hitting the 708 foot tower or its supporting guy wires. None of the species killed, however, was new to the county list.

Acknowledgments are due to the many observers who have supplied information on the birds of the county. In particular, I wish to thank the following: Mr. Frank Munro, who resided at Camp Borden from 1946 to 1953; Mrs. J. L. Westman, Tollendal; Miss A. M. Hughes, Barrie; Mr. Hugh Currie, Barrie; and Mr. A. J. Mitchener, Collingwood.

Annotated List

White Pelican *Pelecanus erythrorhynchos*. The second occurrence of a White Pelican in the county was recorded at Lake Simcoe in 1959. It was first seen by Mr. Thomas Miller of Keswick in Cook's Bay on June 26. Conservation Officer Harold Van Wyck told the writer that he saw this bird on June 28, at the south end of Cook's Bay behind Begg Island and was able to get within 200 yards of it. A few days later it disappeared after being chased by two boys in an outboard motorboat.

Cattle Egret *Bubulcus ibis*. This species has spread rapidly over eastern North America since its initial appearance in Florida in 1948. In Ontario the first one turned up in 1956 (Baillie, 1960). It was considered, therefore, only a matter of time before one would be sighted in this part of the province. To Mr. Jerry Shemilt goes the credit of finding the first Cattle Egret for the county on May 22, 1960. It was in a flooded field along the Nottawasaga River, a few miles north of Angus. Mr. Beverly Geale saw it the next day. An excellent coloured photograph of the egret, taken by Dr. Donald Gunn on May 24, as it perched on a fence post beside the flooded field, is in the writer's possession.

COMMON EGRET *Casmerodius albus.* The following additional observation of this species has been recorded by Currie (1953): "No less than 4 of these southern wanderers were seen by Mr. Richards of Toronto on or about October 5, 1953. The birds were in a marsh about two miles south of Gilford." On July 26, 1961, one was seen feeding in a shallow pond at the outskirts of Collingwood by Mr. A. J. Mitchener.

GLOSSY IBIS *Plegadis falcinellus.* The second county occurrence and the first reported since 1828 was a flock of three Glossy Ibises found by David Elder of Toronto on May 1, 1960 in a flooded field along the Nottawasaga River, a few miles north of Angus. They remained until May 8, at least, and were seen by many observers from Barrie and Toronto.

SHOVELER *Spatula clypeata.* The first summer occurrence for this species was recorded on July 9, 1953, when Miss A. M. Hughes and Mrs. R. Carman observed a male circling in an agitated manner over a grassy marsh northwest of Angus (Currie, 1953). On June 5, 1956, the writer observed two male Shovelers pursuing a female in courtship flight over the Holland River Marsh near Cook's Bay.

HARLEQUIN DUCK *Histrionicus histrionicus.* This handsome duck was added to the county list when two were found feeding with Common Goldeneyes in the open bay off Sunset Point, Collingwood, by Mr. A. J. Mitchener on December 31, 1958 (Mitchener, 1959). They were present for about a week during which time they were seen by several members of the Brereton Field Naturalists' Club of Barrie.

COMMON EIDER *Somateria mollissima.* Currie (1953) has recorded finding a female of this species at the head of Kempenfelt Bay on November 14, 1953. The bird remained in the area for several days where it was seen by observers from Barrie and Toronto. Another was identified at Collingwood on January 2, 1961 by Mr. A. J. Mitchener and Mrs. J. L. Westman.

COMMON SCOTER *Oidemia nigra.* The following additional observations for this rare fall transient may be listed: a female at Collingwood by Mr. A. J. Mitchener on November 11, 1953 (Currie, 1953) and one at Allandale during the period December 14-16, 1956 by Mrs. J. L. Westman.

RED-BREASTED MERGANSER *Mergus serrator.* On July 1, 1952, a pair of Red-breasted Mergansers was found on the Nottawasaga River by Mr. F. E. Courtice while canoeing in the vicinity of Fisher's Rapids below Jack's Lake. On July 16, Mr. Courtice and Mr. A. J. Mitchener again found this pair in the same area. Mr. Mitchener writes: "Mr. Courtice and I canoed on the same part of the river and saw the female with not less than six young accompanied by the male. The female performed the broken wing act while the male flew off and was seen again a few hundred feet further down stream." In this species, according to Bent (1923), both parents take part in the raising of the young while the male of the Common Merganser deserts the female when incubation commences. This is the first breeding record for the county.

GYRFALCON *Falco rusticolus.* Two additional observations of this rare hawk have been recorded by Currie (1953): a white-plumaged bird by Mr. A. J. Mitchener at Collingwood on December 17, 1952 and a dark-phased individual near Barrie on November 3, 1953 by Mr. John Westman.

SANDHILL CRANE *Grus canadensis.* Previously listed as hypothetical on the basis of Sagard's mention of cranes in 1623 (Wrong and Langton, 1939), this species is now added to the county list. Mr. Dale Nash informed the writer that he had seen a Sandhill Crane at his farm in the sixth concession of North Orillia Township in October, 1960. He

described it as a large greyish bird that stood as tall as his shoulder and having a reddish patch on its face. There was ample opportunity to observe the crane as it was present for about two weeks, frequenting a field occupied by a herd of cattle.

STILT SANDPIPER *Micropalama himantopus.* Since the single record for this species was established in 1945 at Barrie, Mr. A. J. Mitchener has identified it on two occasions at Collingwood; on July 24, 1957 and August 6, 1961.

MARBLED GODWIT *Limosa fedoa.* This large wader was added to the county list on May 27, 1961, when one was seen at the Rifle Butts, Collingwood by Mr. A. J. Mitchener, Mrs. J. L. Westman and several other members of the Brereton Field Naturalists' Club. The Godwit was feeding with several Knots and Dunlins and was studied for some time through a Balscope and binoculars from a distance of fifty yards.

RED PHALAROPE *Phalaropus fulicarius.* A single bird seen by Mr. A. J. Mitchener at the mouth of the Nottawasaga River on October 10, 1952 has been recorded by Currie (1953). This marks the fourth occurrence of this rare transient for the county.

PARASITIC JAEGER *Stercorarius parasiticus.* Several additional observations of this uncommon visitor are now at hand. One was watched by Mrs. J. L. Westman as it harried a flock of Common Terns at Allandale on October 2, 1949 (Currie, 1953) and Mr. A. J. Mitchener identified another at Collingwood on October 16, 1956.

ICELAND GULL *Larus glaucoides.* This gull was first recorded for the county in January 1956, at Collingwood by Mr. A. J. Mitchener who viewed one from a distance of 25 feet with the aid of a telescope. Mitchener (1960) again reported two Iceland Gulls at Collingwood on December 28, 1959. These birds were with two Glaucous Gulls and the difference in size and other characteristics were noted.

FRANKLIN'S GULL *Larus pipixcan.* A third county record for this western species was established on November 20, 1956 when Mr. A. J. Mitchener saw one with Bonaparte's Gulls in Collingwood harbour. Its slightly larger size, dark legs and feet, dark mantle with a dark patch around the head were all seen to good advantage.

LITTLE GULL *Larus minutus.* This interesting European gull was added to the county list on October 27, 1957, when one was identified by Miss A. M. Hughes, who later pointed it out to members of the Brereton Field Naturalists' Club. The bird was feeding with a flock of Bonaparte's Gulls along the shore of Kempenfelt Bay at Barrie.

BROWN CREEPER *Certhia familiaris.* Mr. A. J. Mitchener found a nest with six eggs on May 24, 1958 in Nottawasaga Township, near Wasaga Beach. It was behind the loose bark of a decayed balsam fir in dense woods. This is the second nesting record for the county.

CAROLINA WREN *Thryothorus ludovicianus.* Since the initial occurrence of this wren in Innisfil Township in 1939, it has been reported on three subsequent occasions. Currie (1953) has recorded a singing bird found by Mrs. J. L. Westman on May 12, 1953 at Tollandal near Barrie and also states that Mr. Frank Munro saw this species during his stay at Camp Borden from 1946 to 1953. Mrs. Westman reported a wintering Carolina Wren which was present at Tollandal from December 16, 1956 to February 13, 1957.

MOCKINGBIRD *Mimus polyglottos.* This species, which was previously listed as hypothetical on the basis of one sight record at Big Cedar Point, Lake Simcoe in 1941, is now added to the county list. One was present at the feeding station of Mr. Albert Kirby, Robinson Street, Collingwood almost daily from

February 1 to 9, 1958, where it was observed by Mr. A. J. Mitchener. Another Mockingbird was seen by Miss A. M. Hughes on May 17, 1959, in the fourth concession of Vespra Township.

BROWN THRASHER *Toxostoma rufum.* The first winter record for this species was established on December 30, 1951, when one was noted at the feeding station of Mr. Reg. Smith, Duckworth Street, Barrie by members of the Brereton Field Naturalists' Club during their annual Christmas census (1952).

BLUE-GRAY GNATCATCHER *Polioptila caerulea.* The first observation of this species for the county was made on May 8, 1953, when Mr. A. J. Mitchener saw one at Sunset Park, Collingwood (Currie, 1953).

BOHEMIAN WAXWING *Bombycilla garrula.* This species is occasionally noted in winter but the unusual invasion that occurred during the winter of 1958-59 reached such proportions as to be worthy of special mention. The advance guard of this flight was first reported by Mr. R. G. Dingman on December 24, 1958, when he saw a flock of sixty at his home in Barrie. During the Christmas census on December 27, 1958, 116 were counted in the Barrie area (Hughes, 1959).

On December 30, 1958, Mr. A. J. Mitchener found flocks of fifteen and forty, respectively, feeding on the abundant crop of mountain ash berries at Collingwood. On January 11, 1959, Mr. Charles Molony, A. J. Mitchener and the writer saw sixty at the Collingwood Fish Hatchery.

Messrs. E. Stark, W. W. Smith and R. W. Trowern counted 400 Bohemian Waxwings on January 4, 1959 in Barrie. Mr. Charles Molony and the writer saw 110 near the Royal Victoria Hospital on January 11 and Mr. J. L. Baillie noted ninety-seven on Poyntz Ave., Barrie on January 24, 1959.

Such large numbers, unprecedented within living memory, attracted naturalists from as far away as Buffalo, N.Y.

YELLOW-THROATED VIREO *Vireo flavifrons.* Mr. D. S. Miller had a pair of Yellow-throated Vireos under observation from July 1 to 4, 1954 at Oro Beach, Lake Simcoe. Actions of the birds indicated probable nesting but the actual nest was not located.

GOLDEN-WINGED WARBLER *Vermivora chrysoptera.* Currie (1953) has recorded that he and Miss A. M. Hughes found a pair of these birds established near Mac railway station (west of Barrie) in the summer of 1952 and that at least four others were seen during that summer in or near the Minesing Swamp.

Mr. Douglas Sumner informed the writer that he located a male and female near Mac on July 13, 1956 and on the following day saw a young bird out of the nest being fed by an adult. This constitutes the first breeding record for the county.

BREWSTER'S WARBLER *Vermivora chrysoptera* x *pinus.* The first observation of this interesting hybrid near the junction of the Pine and Nottawasaga Rivers by Mr. Frank Munro on July 31, 1949 has been reported by Currie (1953). Another was noted by Miss A. M. Hughes and Mr. H. Currie on May 15, 1955 along the Sunnidale Road about three miles from Barrie. A third Brewster's Warbler was seen on May 23, 1956 by Mrs. J. L. Westman at Tollendal.

CERULEAN WARBLER *Dendroica cerulea.* Mrs. J. L. Westman and Mr. W. A. Bell found a singing male in the Minesing Swamp on June 20, 1954, establishing the first record for the county. Presumably the same male was singing in the same locality when viewed by Mrs. Westman, Dr. E. G. Bilkey, Mrs. O. E. Devitt and the writer on June 27. On May 21, 1956, another was seen on the tenth concession sideroad of Vespra

Township by Mrs. Westman and other Barrie observers.

HOODED WARBLER *Wilsonia citrina.* The first occurrence of the Hooded Warbler in the county was established on June 9, 1959, when Mrs. J. L. Westman found a singing male at Tollendal near Barrie. This bird was under observation for almost an hour.

WESTERN MEADOWLARK *Sturnella neglecta.* The initial observation of this species in the county by Mr. Frank Munro some three-quarters of a mile west of Holly on May 9, 1953 has been recorded by Currie (1953).

Mr. George North and Mr. George McBride discovered another singing male on highway 88, one and one-half miles west of Bradford on July 28, 1957. In the same general area on July 31, the writer was able to secure a young Western Meadowlark, not long out of the nest, to establish the first breeding record for the county. The specimen is now in the Royal Ontario Museum.

RUFOUS-SIDED TOWHEE *Pipilo erythrophthalmus.* This species was noted in winter for the first time at the feeding station of Mrs. J. L. Westman at Tollendal and was recorded on the Barrie Christmas census of December 27, 1958 (Hughes, 1959). Another towhee was seen on January 7, 1961 during the annual Christmas census at Barrie.

GRASSHOPPER SPARROW *Ammodramus savannarum.* The first county breeding record for this species as recorded by Currie (1953) was that of a nest containing four eggs discovered by Mr. Frank Munro on June 21, 1953, at Camp Borden.

HENSLOW'S SPARROW *Passerherbulus henslowii.* Besides the two locations previously reported for this rare sparrow (at Holland River and just west of Barrie), a third summering area was discovered by Dr. C. H. D. Clarke, May 26, 1955, on the north side of Cranberry Lake in Tiny Township.

CLAY-COLORED SPARROW *Spizella pallida.* The first two breeding records for the county as recorded by Currie (1953) were: Mr. Frank Munro watched a young bird, just able to fly, being fed by a parent on July 13, 1952, between the Camp Borden landing field and the Camp Borden-Alliston highway; again on July 11, 1953, he found a nest containing four young birds in the same area.

WHITE-CROWNED SPARROW *Zonotrichia leucophrys.* An individual seen in Barrie on December 27, 1958, during the annual Christmas census of the Brereton Field Naturalists' Club, was the first winter occurrence for the county (Hughes, 1959).

FOX SPARROW *Passerella iliaca.* The initial winter observation of this handsome sparrow was made on January 28, 1961, when one was noted in a small flock of juncos on the seventh concession sideroad of Essa Township, near Ivy by Mrs. J. L. Westman.

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NOTES ON A COLLECTION OF AMPHIBIANS FROM THE SOUTHWESTERN UKRAINE, U.S.S.R. AND ADJACENT CZECHOSLOVAKIA

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A VALUABLE amphibian collection of approximately one hundred and fifty specimens was donated to the National Museum of Canada in April 1959 by Dr. Vadim Vladykov of Ottawa University. These have been catalogued as *NMC 4280-4372* (inclusive). This collection was made during the years 1924 to 1928. A detailed map showing most of the localities and a description of the Carpatho-Ukraine region may be found in Vladykov (1931). Most of the localities are in the Carpatho-Ukraine (Russo Sub-Carpathian: Vladykov 1931), but three are in eastern Czechoslovakia. While the majority of specimens bear labels giving locality data, the remainder were labelled with the indefinite "Pod. K. Rus". Pod. K. Rus is an abbreviation for Podkarpatska Rus, a name which was sometimes used for the Carpatho-Ukraine.

FIGURE 1. Map of the southwestern Ukraine (Carpatho-Ukraine), U.S.S.R. and adjacent Czechoslovakia, after Vladykov (1931) with the addition of Nevitske, Ozirna, Ruskal and Luchki. The name "Sinatorium" is doubtful and cannot be located. Also, the spelling of several place names have been changed slightly from that of Vladykov. These changes have been made on the authority of Mr. M. Borowyk and are as follows: Vajani = Vajany, Mukacevo = Mukachevo, Berehovo = Berehova, Vel Bychiv = Vel Bychki, Lazescina = Lazestsina, Stochovet = Stokhovets.

Seventeen species of amphibians have been recorded from the Carpatho-Ukraine. The Vladykov collection contains thirteen of these species, including a series of *Triturus montandoni*, the Carpathian newt. This species is known only from eastern Czechoslovakia, southwestern Ukraine, U.S.S.R. and northern Romania.

The collection has been identified by the author to the species level only, as the necessary comparative material for subspecific determination has not been available. A list of the species with the number obtained at each locality has been compiled so that herpetologists may note the number available for study in the National Museum.

I wish to thank Mr. F. Cook, Mr. D. McAllister and Mr. M. Borowyk of the National Museum of Canada; also the American Museum of Natural History for the loan of comparative material.

TABLE 1—List of species in the Vladykov donation with the locality and quantity of each

	Southwestern Ukraine, U.S.S.R.										?	Czechoslovakia		
	Stokhovets	Lazestsina	Vel Bychki	Podplesie	Berehova	Mukachevo	Ozirna	Uzhorod	Nevitske	Pod. K. Rus	Sinatorium	Vajany	Luchki	Ruskal
Salamandra salamandra..1								1						
Triturus alpestris.....9										9				
Triturus cristatus.....33			7	2						22			2	
Triturus montandoni....14										1			4	9
Triturus vulgaris.....31		2	12	2			1	2		7		1	5	
Bombina bombina.....1										1				
Bombina variegata.....17		3	1	6		2				2			2	1
Pelobates fuscus.....1								1						
Bufo viridis.....1							1							
Rana arvalis.....8		2						1		4		1		
Rana dalmatina.....9		4		1			2				2			
Rana temporaria.....13	1	1			5				2	2	1			1
Rana esculenta.....7						4	3							

Additional species recorded in the literature from this area but not represented in this collection are: *Bufo bufo, Bufo calamita, Hyla arborea* and *Rana ridibunda*. The latter form is considered a full species by some herpetologists while others consider it a race of *R. esculenta*.

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FIELD OBSERVATIONS OF VARIATION IN *VACCINIUM ULIGINOSUM* L.*

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THE BOG BILBERRY or Dwarf Blueberry, *Vaccinium uliginosum* L., is a very common shrub in parts of northern North America and northern Europe and occupies a wide variety of habitats. The writer had the opportunity of making extensive field observations of this species in 1948 while serving as a member of the Port Radium Expedition of the Botanical Gardens, University of Michigan, for the Detection of Hereditary Mutations in Plants. This expedition was supported by the Bureau of Naval Research, U. S. Navy. These studies were made in the vicinity of Great Bear Lake and Great Slave Lake, and at Coppermine on the shore of Coronation Gulf, Northwest Territories, Canada. During the summers of 1957, 1958, and 1960, while employed as botanist for the U. S. Geological Survey, he made numerous observations on this species through much of Alaska.

This shrub grows in all parts of this state, and is one of the few woody plants with such widespread distribution (Hultén, 1948, p. 1258-1261). It does not grow in the densely shaded forests of hemlock and spruce of southeastern Alaska; otherwise it is to be expected in Alaska wherever any species of trees are found, and its range extends beyond the tree line into the arctic alpine and arctic tundra zones. Spetzman (1959, p. 49) gives its habitat in the Artic Slope of Alaska as "Cutbanks, shrub meadows, wet sedge meadows, and rocky alpine slopes." In the Great Bear Lake region it is most commonly found in moist, peaty soil near the outer margins of *Sphagnum* bogs. It also occurs in the isolated humus deposits that form in small ravines and depressions of the extensive igneous outcrops of this region.

The shrub is commonly decumbent, or ascending to 6 dm high. However, in alpine situations near its altitudinal limit it may be completely depressed, having only the leafy branch tips protruding from the moss or lichen mat, its rate of growth just keeping pace with the growth of these associated plants. This often results in the development of thick woody stems a meter or more in length buried almost horizontally in the organic accumulation. This main leafless stem bears only a few leafy branches. In such situations it is suggested that the rate of moss and lichen growth may be rather accurately determined by correlating the thickness of this mat directly above such a buried stem with the age of the stem (determined by ring counts) at this point. At one site in the Alaska Range near Mount McKinley preliminary studies showed a mat thickness of approximately 8 cm directly over a fifteen-year-old stem. As conditions become less favorable for the *Vaccinium*, the mosses and lichens may grow at a faster rate than does the shrub, and so eliminate it from the community. On the other hand, this species

*Publication authorized by the Director, United States Geological Survey.

may grow as an erect shrub as high as 1.5 m in moist, protected ravines, particularly if forced into the upright habit by the growth of dwarf birch (*Betula nana* subsp. *exilis* (Sukatch) Hult.) or other competing shrubs.

In some parts of its range the fruit is reported to be sweet and widely used for food. Anderson (1959, p. 372-373) writes, "This is the common blueberry of interior Alaska and used in large quantities. In southeast Alaska it is largely a bog or alpine dweller and not much used." Wiegand (1947, p. 3424) quotes W. M. Munson as follows: " . . . its fr. [fruit] though of poor quality, is used for food by the natives of the Northwest." Fernald (1950, p. 1132), Rehder (1947, p. 752), and Britton and Brown (1936, p. 699) each characterize the fruit as "sweet". In describing this plant in the Canadian Eastern Arctic, Polunin (1940, p. 315) says, "*Vaccinium uliginosum* var. *alpinum* is one of the outstanding plants over much of our area, giving the most brilliant tints to the hillsides in autumn, the most delicious fruits to all around, and often dominating considerable areas of sheltered country." Hultén (1948, p. 1261) writes of this species, "The form of the fruit is very variable in Europe as well as in America, and it seems to me that the berries of var. alpinum have a sweeter taste than those of the main type. They are good to eat, which is not the case with the berries of the Scandinavian plant, which have a very astringent taste." Hultén (*op. cit.*) considers the var. *alpinum* Bigel. to be one of two races of this species which occur in Alaska and elsewhere, and believes that it is hardly possible to separate the races by a distinct line of demarcation.) Harshberger (1928, p. 232), in writing of a variety of this species which he described from Pedro Dome near Fairbanks, Alaska says, "The writer in finding *Vaccinium uliginosum* var. *pedris* feels that he has discovered a new variety of whortleberry. The fruit of this form is elongated and ellipsoidal, instead of spherical, and the berries are sweet instead of tart, as in *Vaccinium uliginosum.* In other characters, the presence of bloom on the fruit and in the vegetative characters, the new variety agrees with the species." However, it should be noted that on the same page the Latin diagnosis of this variety states, "Bacca ovata; fructus dulcissimus."

It has been the experience of the writer that throughout Alaska the fruit is rather uniformly sweet and pleasant to the taste, and that the fruits from Pedro Dome are not especially unique in this respect. However, in the Great Bear Lake region, the tasting of hundreds of fruits revealed but few that were distinctly sweet and edible. By far the greater number were rather insipid, or had a slightly tart, somewhat astringent taste not very pleasant to this observer. One outstanding exception was found; Specimen No. *2949*, collected July 14, 1948, bore fruits which were rather large (about 1 cm long), of a dark blue-black color overlain with a dense bloom, and which were distinctly sweet and pleasant to the taste. This plant was growing in sandy soil of a burned-over spruce forest two miles northeast of the R.C.A.F. camp, Sawmill Bay. Other plants growing adjacent to it bore the usual insipid fruits. From these experiences it may be summarized that fruits of the Bog Bilberry in this region ordinarily are scarcely edible; they are certainly inferior in this respect to the fruits of the Red Bearberry (*Arctostaphylos alpina* subsp. *rubra* Hult.) with which they often grow.

The color of the fruits was found to be quite uniform throughout the entire range studied—black or bluish-black, covered with a heavy white bloom. This agrees with the literature cited in this paper. However, in the Great Bear Lake region an exception was found. Specimen No. *3247*, collected July 30, 1948, in rich humus at the foot of a clay hill just below the lower rapids of the Sloan River, Hunter Bay, bore fruits that were almost black, with no trace of white bloom. Otherwise the fruits were similar to those of surrounding plants, and were equally insipid.

The species ordinarily shows some variation in fruit shape, the fruits being most commonly ovoid to spherical, but may have modifications of these shapes. Large fruits often tend to be somewhat elongated or cylindrical whereas small fruits are usually more nearly spherical. Anderson (1959, p. 372) describes the fruits as being " . . . from oblate to cylindrical, 6-15 mm. in diameter." While collecting specimens in an area of flat, peaty soil overlying thin glacial till at the lower end of McDonough Lake, Labine Point, Great Bear Lake the writer found a striking display of fruit variation in a "colony" of less than 400 square meters in extent. The plants were all rather low, ascending to 3 dm in height, and were the dominant plants of the area. Almost every individual plant showed easily-recognizable variation in fruit shape, and all fruits on a particular plant tended to vary in the same manner from the typical fruit shape of this region. In order to ascertain that these were actually clonal variations, a number of plants were pulled up. It was found that if apparently separate "plants" were actually clonal offshoots with root connections, the fruits varied similarly in both "plants." If the "plants" were not connected, but actually separate plants, the fruit variation was quite different. There was no appreciable variation in other fruit characteristics, or in vegetative parts. Six clones were selected for study which were considered to cover the range of variation, and sketches of the mature fruits were made before putting the specimens in the plant press (Figure 1). These six variant fruit forms may be described as follows:

1. Ovoid. Fruit ovoid-spherical, slightly asymmetrical. This form is considered to be the typical fruit shape for the region as a whole. Specimen No. *3139*.

2. Spheroid. Fruit somewhat spherical, but compressed axially. Specimen No. *3144*.

3. Pyriform. Fruit pyriform, generally asymmetrical. Specimen No. *3138*.

4. Subconstricted. Fruit ovoid to somewhat pyriform, with slight constriction near the pedicel. Specimen No. *3141*.

5. Cylindrical. Fruit large, cylindrical, with prominent constriction at about one-third the distance from pedicel to calyx. Specimen No. *3140*.

6. Subcylindrical. Fruit subcylindrical, often as broad as long, occasionally somewhat spherical. Specimen No. *3143*.

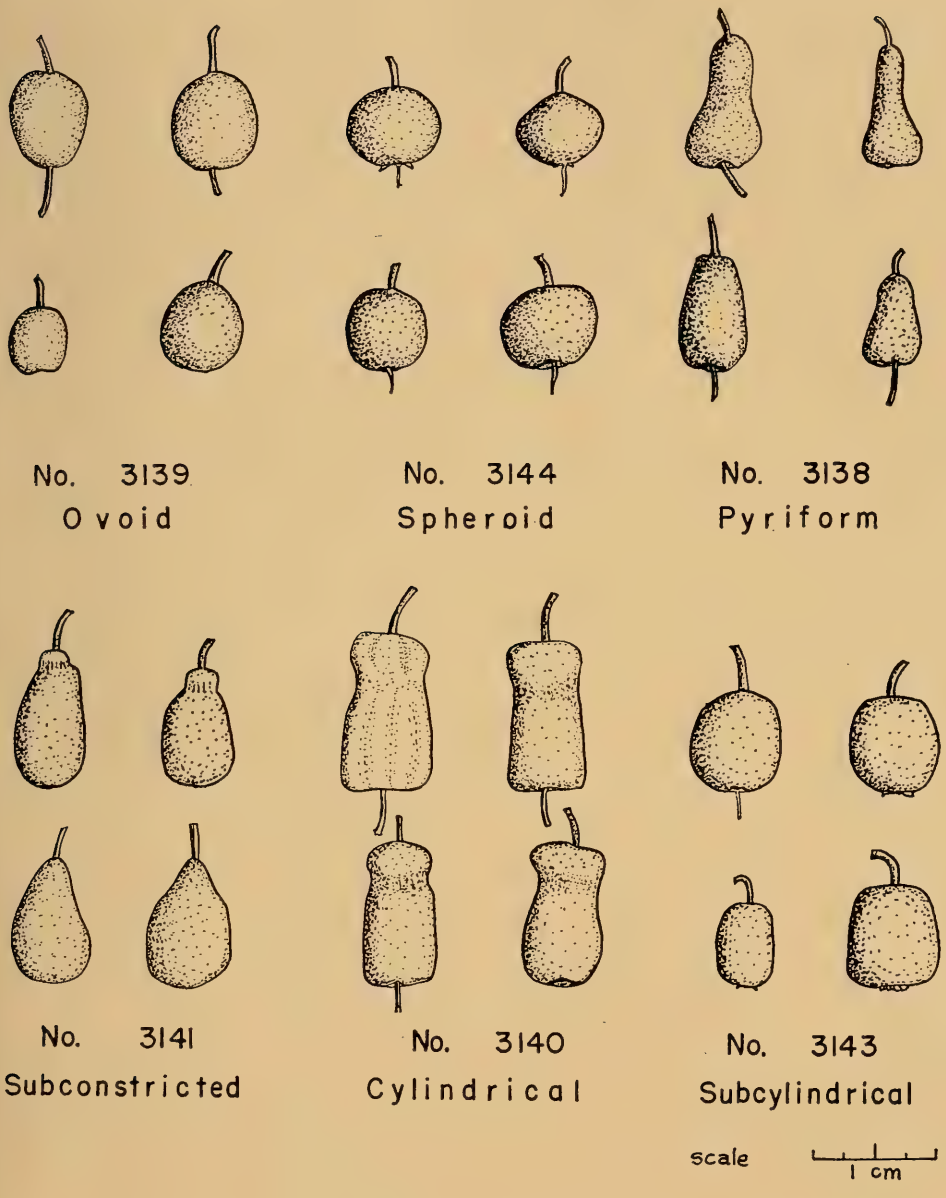

FIGURE 1. Fruit variation in *Vaccinium uliginosum* L. The numbered groups represent the range of fruit shape borne on a single clone. The upper right drawing in each group represents the typical fruit shape of the clone, and the other three drawings represent variants. All drawings were made from fresh mature fruits.

These fruits were quite ripe when collected on July 23 and had the usual insipid taste of the fruits of this region.

It is interesting to note that Gates observed similar fruit variation in this same species in Russian Lapland, which he describes (1928, p. 152) as follows: "I observed a variety of *Vaccinium uliginosum* with quadrate fruits, another variety with pear-shaped, and a third with elongated cylindrical fruits."

Although the variation in fruit shape observed at Great Bear Lake is not in itself especially remarkable, the occurrence of so much variability in such a small area seems quite striking when contrasted with the slight variability in fruit shape that was found throughout the area. It may be significant that directly underlying this interesting colony is a vast deposit of pitchblende, and surface outcrops of this mineral can be observed a few yards away. These deposits are very localized, especially the surface exposures, and are not known to occur in adjacent areas of this region where great numbers of this plant were observed. The long and continuous exposure of this colony to radiation from the uranium deposits directly beneath it may have been a factor initiating genetic change of this species, giving rise to the fruit variation described above, which has been perpetuated through vegetative reproduction of these clones.

The late Professor H. H. Bartlett of the Department of Botany, University of Michigan commented on these forms (written communication) as follows: "In the case of your *Vaccinium* forms an ancient, stable genetically isolated type has produced new forms which can reasonably be conceived of as having been caused by local unusually intense radiation. The original modification of each chromosome locus presumably produced a whole, or more likely, a partial plant which was in a hybrid condition. By Mendelian segregation it presumably produced a stable, hereditary form. My opinion is that your forms are taxonomic entities of a low grade, probably single-factor types. They would not necessarily be given any taxonomic status at all if they had been produced in horticulture by the crossing of closely allied types, followed by segregation. They have, however, a very different and far more interesting status. There can hardly be any doubt that they are genetic entities. They have a degree of difference which entitles them to be considered varieties or forms, not subspecies or species." The writer, however, does not propose to give them taxonomic status in this paper.

If this wide range of variation in this small area is in fact related to radiation mutation, this characteristic variability may be useful in geobotanical exploration as an indication of subsurface radioactive deposits.

The writer wishes to acknowledge the encouragement of this study by the late Professor H. H. Bartlett, who was the director of the Port Radium Expedition. He also wishes to express appreciation to Dr. William C. Steere, the leader of the field party, for his advice and assistance on many matters throughout this field season.

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CORRECTION NOTE

On page 112, Line 8 of Vol. 76, No. 2, in John L. Kirwan's article *Geology of part of the townships of March, Huntley and Nepean. Carleton County, Ontario,* "granoblastic" should be corrected to read "granitic".

REVIEWS

A Revision of the Reindeer and Caribou, Genus Rangifer

By A. W. F. Banfield. National Museum of Canada Bulletin 177, Biological Series 66. 1961. 137 p. $2.00.

The task of making a comprehensive study of a genus of large mammals with a holarctic distribution is so formidable that few have made the attempt. It is virtually impossible to bring together in one place any substantial part of the available specimens of a large, antlered mammal so that they can be readily available for the searching study that is so necessary to reach valid conclusions. For this reason most of the attempts to present a world appraisal of speciation in the genera of the Cervidae have involved more intuition than objective analysis. Such was certainly true of the treatment of the genus *Rangifer* by Jacobi (Das Rentier, Akad. Verlog. m.b.H., 1931) and by Ellerman and Morrison Scott (Checklist of Palearctic and Indian Mammals, British Museum 1951). The study under review, however has made a serious effort to circumvent these difficulties and has brought together, for the first time, the quantitative data covering available specimens of New World and Old World *Rangifer*. In all, 855 skulls were studied.

The revision presents a summary of the information available on individual variation, difference due to sex, to age and to season as they influence systematic judgements. Some cranial and dental abnormalities are also discussed.

A praiseworthy attempt has been made to relate the few known fossil reindeer and caribou remains to the current understanding of the systematic status of recent species and subspecies. The conclusion reached is that 4 Quaternary and 9 recent subspecies are recognizeable, all part of a single species complex *Rangifer tarandus*. In North America the tundra area east of the Mackenzie River is assigned as the range of the subspecies *R. t. groenlandicus*, while the forested areas from Labrador and Newfoundland to the mountains of British Columbia are found to be occupied by a single subspecies *R. t. caribou*. *R. t. pearyi*, *R. t. granti* and *R. t. dawsoni* complete the New World group. One of the problems that arises in the downgrading of variable species with their subspecies groups to the status of subspecies is what status to assign to the populations, former subspecies, that have certain distinctive characteristics, but can no longer be regarded as subspecies. Banfield has referred to these as demes but unfortunately the deme concept and its application to the present study are not discussed as such in the text material.

Under each subspecies there is given a most useful outline of past and present distribution, present status, taxonomic history and a list of the specimens examined and the museums in which they are housed.

In any study of this length and complexity some errors of spelling and grammar are to be expected and excused. The present paper has perhaps exceeded this quota somewhat.

Certain features of a technical nature merit further comment. In the matter of interpreting the systematic status of the fossil reindeer, I fail to see any evidence to support the separation of *R. t. fennicus* of the recent from *R. t. quettardi* (Demarest), the subfossil form of western Europe. If this is the case, the latter name becomes the valid one for Eurasian forest reindeer of the recent. *Rangifer tarandus fricki* Schultz and Howard, of the Alaskan Quaternary deposits, merits further and more searching analysis to discover whether or not it rests its recognition on grounds that would be accepted for living subspecies.

The author has obviously done much work on amassing his quantitative data, sorting it and resorting it. He has calculated standard errors and standard deviations for the useable samples representing several characters for both subspecies and demes. Various techniques of statistical analysis and presentation were tried and finally the Duncan Multiple Range test decided upon as the one best suited to the problem. To me the reasons behind nomenclatural decisions taken would have been more easily appreciated had a modified Dice-Leraas or Hubbs graph been presented. This, however, may be my own bias.

The absence of any text reference to the actual differences in quantitative characteristics differentiating between adjoining subspecies or demes makes this work somewhat difficult to use in the interpretation of newly taken material. Nowhere are the details presented upon the graphs and tables discussed in the text in support of the conclusions drawn. The linear graphs given on Figures 8 to 14 bear no legend to explain the significance of the boxes erected upon the range lines. Are the open boxes one standard deviation and the black boxes one standard error on each side of the mean? If so, why not show 2 standard errors, so that differences significant to the .05 level could be approximated by direct reading of the graphs? It would have greatly facilitated comparisons if the sexes had been placed upon separate graphs.

On Table 8 in Appendix I asterisks are used for two purposes. To learn what the asterisks in the vertical columns mean it is necessary to refer to p. 15. Referring further to these, and subsequent tables, the placement of the asterisks makes it difficult to tell which comparisons are being indicated as significant.

Despite these shortcomings this revision is a valued addition to the literature on Holarctic mammals and it should become part of the working library of any student of mammals and of wildlife management in the Northern Hemisphere.

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The Amphibians and Reptiles of Illinois

By PHILIP W. SMITH. Illinois Natural History Survey, Bulletin 28(1). Urbana, Illinois, 1961. 298 p. $3.00.

The Amphibians and Reptiles of Illinois is a comprehensive work covering the 109 forms recorded for that state. "The objectives of this report on the amphibians and reptiles of Illinois are threefold. The first is to provide a critical review of the species and subspecies known to inhabit Illinois. The second is to present detailed distributional information for these animals in the hope that the data may contribute to the knowledge of the ecology and biogeography of Illinois. The third is to call attention to variation trends that I have discerned within Illinois and that will enable future investigators to utilize character analyses for populations occurring in limited parts of the state."

The life histories of many amphibians and reptiles are adapted to narrow ecological limits and, consequently, they make excellent indicators of climatic zones. In Illinois, only twenty-five species are state wide in their distribution, and the rest form all sorts of distribution patterns. These patterns are a reflection of both the present-day climate, and the post glacial climatic sequence. Therefore, not only do these animals demonstrate natural ecological divisions within the state of Illinois, but their distribution patterns also indicate the direction from which they entered the area after the retreat of the glaciers. At present, there are sixty-nine species which have met limiting barriers to their dispersal somewhere in Illinois. This sort

of analysis of the amphibians and reptiles within one area is of great consequence to the taxonomist, for it shows how species can disperse, become isolated, differentiate into various forms, and make contact again. In this manner the taxonomist can describe relationships of recent forms, both in space and in time.

This publication is printed on glossy paper, 7 x 10, which allows for large illustrations. In fact, the photographs of many species are several times larger than life. The maps are also excellent because of their large size. The distribution maps deserve special comment because, in addition to the map depicting the distribution of the species within Illinois, there is a small insert map indicating the entire range of the species within the United States. The distribution maps for Illinois have both general shaded areas and the actual spot records on which the shaded areas are based. There is also an extensive list of references and a fine index.

The book is especially recommended to those interested in amphibians and reptiles, and in the subject of Zoogeography, and to others because of the excellence of the photographs and maps.

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Wildlife Sketches — Near and Far —

By BRUCE S. WRIGHT. Fredericton, N.B. Brunswick Press, 1962. 288 p. $5.95.

There have been few more sobering words penned in the endless plea for conservation than the starkly resigned epilogue to this volume: "Wildlife habitat is decreasing all over the world as the human population grows. It follows that we who live today can see more of the great and small creatures that populated the earth before our own kind dominated the scene than will our great-grandchildren . . . I am thankful that my turn came for my brief "run on deck" before the erupting masses of my own species crowded off the planet the last lion, caribou or blue whale. So far I have made the best of it".

The vivid pages of the text carry the truth of the epilogue home—the glimpses of the author's "run on deck" range from his beloved New Brunswick to Africa and include the necessarily limited but enlightening observations of wildlife seen through the cloud of a man-made war. Throughout the text is the stamp of perceptive personal observation and diligent literature research. For those who have neither the time, patience, or opportunity to search for information through the often woefully dry original scientific reports on a wide variety of wildlife this will serve, in addition to its value for prose and message alone, as a palatable source of facts combined with conjecture.

The individual chapters were originally written and published as entities in themselves and have, as the writer explains in his introduction, not been extensively reworked. This unfortunately leaves a certain repetition of style and professional cliches. A trifle grating is the tendency in certain selections to talk down to his reader and use such phrases as "Mr. Respectable Citizen" which are perhaps more suitable for the eventide serialized nature stories many of us were raised on.

However, nothing can detract from the rugged force and deep, honest appreciation for wilderness and wildlife that pulses through every phrase. These stories will open new vistas of perspective to the uninitiated and conjure warm, often familiar images to those who have personally tasted at nature's fountain. In addition, it should admirably perform its co-aim and win staunch supporters for the crucial conservation crusade.

FRANCIS R. COOK

The Lake Sturgeon, a History of Its Fishery and Problems of Conservation

By W. J. K. HARKNESS and J. R. DYMOND. Ontario Department Lands and Forests. 1961. 121 p.

Although there are hundreds of papers on some species of Canadian fishes, rarely is this dispersed literature brought together in one account. It is even more rare that such an account should be both enjoyable to read and yet knowledgeful. The material ranges from graphs of catch and growth to tall tales and legends about sturgeons. There are sections on size (up to 310 pounds), distribution, habits, food, growth, reproduction, artificial propogation, caviar, isinglass, competitors, predators, fishing methods, Indians and sturgeon, the fishery, and conservation. Illustrating the booklet are a map, numerous photographs and graphs.

The decline of the lake sturgeon fishery is well documented. For example the annual catch in Ontario around the turn of the century was over 1,200,000 pounds, but in the 1950s was under 200,000 pounds. While intensive fishing contributed its share to the decrease of the species, also important were the construction of dams and pollution. The low effective reproductive rate of the species prevents rapid recovery. Does the decline of the lake sturgeon presage the decline of further species?

To sportsman, fisheries biologists, administrators and to ichthyologists the writing of similar monographs on other species would be useful and entertaining.

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Our Synthetic Environment

By LEWIS HERBER. A. A. Knopf, New York. 1962. *viii* + 285 p. $6.50.

Considering the ever-increasing problems caused by the pollution of the land, water and air, it is somewhat surprising that we had to wait until the year 1962 for the appearance of a book covering the various ramifications of these problems. Fortunately, *Our Synthetic Environment* by Lewis Herber covers this niche very well.

In his foreword the author states that the main qualification he can claim on the subject is a long and patient study of other men's works and that the book is concerned with the problems of our natural environment as they involve the needs of man. The author has done an admirable job in reviewing a vast amount of technical information and by writing a book in clear, non-technical language which can be read by the average interested reader.

Along with the wonderful scientific advances achieved by our civilization have come dangers, many of them only vaguely known to most of us. It is these dangers which are referred to more specifically.

The first chapter deals with an analysis of the problem. The second chapter discusses agriculture and health. He stresses the value of good soil management, and points out that the thoughtless use of chemical agents in the production of food may well make it possible to grow crops in great abundance, but of low quality on soil that is basically in poor condition. Crop production has resulted in large expanses of single crop species and simplification of the landscape, which in turn creates highly favorable conditions for an infestation. If chemical controls become increasingly lethal, the earth may prove to be incapable of supporting a viable, healthy human species.

In the chapter on urban life and health, the author refers to the urban man as a "nervous, excitable, and highly strained individual who is burdened by continual personal anxieties and mounting social insecurity".

In his chapter on the problem of chemicals in food, the author points out several implications the average consumer ought to know more about.

The chapter on environment and cancer is very thought-provoking. The connection between the rising incidence of lung cancer and changes in man's environment has affected traditional thinking about the causes of cancer profoundly.

Radiation and human health, dealt with in the next chapter, is something we all should know more about. The various dangers involved are discussed under the headings: The effects of radiation, the problems of X radiation, fallout and the nuclear age.

When dealing with human ecology in the next chapter the author arrives at the conclusion that "by oversimplifying the natural environment, we have created an incomplete man who lives an unbalanced life in a standardized world. Such a man is ill—not only morally and psychologically, but physically".

The final chapter discusses health and society.

The author states that his book is guided by a rational humanism, not a sentimental humanism. On the whole the reviewer would agree that he has used a rational approach, but here and there a certain amount of bias in selecting data to substantiate his arguments seems apparent. The book is well written and organized. References are compiled in a "notes" section, an effective and useful method of presenting supporting evidence. The book is well edited and it contains very few typographical errors. The reviewer can recommend it highly to any reader who wants to know more about his place in our artificial environment with its many problems.

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A Book of Canadian Animals

By CHARLES PAUL MAY. Illustrations by John Crosby. The Macmillan Company of Canada Limited, Toronto, 1962. 115 p. $2.75.

It is well known to publishers in Canada that there is a real need for Canada-oriented nature books for children. The books that fulfill this need will serve as important educational tools and will, it is hoped, be financially successful as well. After carefully reading this book, I feel that it was written in an attempt to exploit this deficiency for financial gain, but that the author has little to say of educational value.

A Book of Canadian Animals, about *some* Canadian *mammals*, not animals in general, was written by a non-Canadian who has "visited Canada at various times". Mr. May writes in a condescending style that can be best illustrated by a few passages.

"If you see a doormat crawling along the ground, it is probably a badger . . . Its silvery grey hairs drag along the ground at its sides so you may not be able to see its legs . . . The badger likes country that is open . . . If you are in forest, don't look for the badger."

"The little brown bat gets its name from its pretty brown fur, which is soft and silky. There is also a big brown bat, but it is actually rather small. Because it is bigger than the little brown bat, it is known as the big brown bat." (!)

Another gem, "The first time you see a lemming you may think it is a mouse. Don't let this *worry* you, (italics mine) as most people think the same thing." Mammalogists *and* Webster's New International Dictionary define a mouse as "any of numerous species of small rodents . . . ".

Twenty-eight species of mammals are treated (out of approximately 191 species in Canada) in the same stilted manner, with paragraphs on general appearance (sketchy), distribution (not always correct) and life history (brief). Each

species is illustrated by black and white drawings of young and of adults.

Mr. May has completely underestimated the ability of children of a reading age. Children to whom I have shown this book were either too young to read it at all, or were old enough for more mature stuff.

In many instances the text only borders on the truth and the illustrations are only fair. The young lynx on page 59 is an anatomical impossibility.

Until something better comes along children will do better to still reach for the books of Victor Cahalane, Osa and Martin Johnson, the Murie brothers, and Ernest Thompson Seton.

PHILLIP M. YOUNGMAN

The Orchids of British Columbia

By ADAM F. SZCZAWINSKI, with illustrations by Frank L. Beebe. British Columbia Provincial Museum, Handbook No. 16, Victoria, B.C., 1959. 124 p. 50 cents.

The Heather Family (*Ericaceae*) of British Columbia

By ADAM F. SZCZAWINSKI, with illustrations by Betty Newton and Ann Hassen. British Columbia Provincial Museum, Handbook No. 19, 1962. 205 p. 50 cents.

Guide to Common Edible Plants of British Columbia

By ADAM F. SZCZAWINSKI and GEORGE A. HARDY, with illustrations by Frank L. Beebe. British Columbia Provincial Museum Handbook No. 20, 1962. 90 p. 50 cents.

Among Canada's ten provinces, British Columbia is by far the most mountainous, having a topography not unlike that of Switzerland. For that reason alone botanical exploration has been most difficult, and vast areas of the northern and central parts remain largely unexplored botanically. This is not surprising in view of the sparse population concentrated mainly in the southernmost parts, the few botanists who have been able to carry out exploratory work, and the fact that in area British Columbia is roughly twenty-two times as large as Switzerland, but with only one fourth of the population. Although future exploration may add relatively few species of vascular plants to those now recognized in the Province, their general and local distribution is known mainly for the parts covered by J. K. Henry's *Flora of Southern British Columbia,* published in 1915, and now long out of print, and by J. W. Eastham's supplement, (Special Publication No. 1, British Columbia Provincial Museum, 1947).

Pending the appearance of a modern flora of British Columbia, the illustrated handbooks published by the Provincial Museum meet an urgent need for guides to groups or families of plants. The first number in the Handbook series appeared twenty years ago. It is entitled *Fifty Edible Plants of British Columbia,* and was prepared by G. A. Hardy of the Provincial Museum staff. Because of a continuing demand for this popular guide, long out of print, Dr. Adam F. Szczawinski, Curator of the Herbarium of the Provincial Museum, has now joined Mr. Hardy to produce an entirely new and enlarged guide to the edible plants of the Province, adding new and better illustrations as well as new data from the northern parts, an area not well represented in the earlier edition.

Handbook No. 9, by William A. Hubbard, entitled *Grasses of British Columbia,* published in 1955, is also out of print, as is T. M. C. Taylor's *The Ferns and Fern-Allies of British Columbia,* published a year later as Handbook No. 12. The latter provides conventional keys to genera and species, a glossary of botanical terms, comprehensive descriptions, notes on habitat and geographic distribution, and excellent line drawings of all species known to occur in the Province.

In two of the latest volumes of the "Handbook" series, Dr. Szczawinski has new dealt with the Orchid and Heath

families. To the style and coverage already set by Dr. Taylor in *Ferns and Fern-Allies*, has been added very usful maps giving the known distribution within the Province for each of the thirty species of orchids known from British Columbia. The interesting pattern of distribution of species, as shown by these maps, is to some extent the outcome of insufficient and spotty botanical exploration; but it is probably an oversimplification when the author (Handbook No. 16, p. 18, and again on p. 13 of Handbook 19) observes that "---- the maps cannot give a complete picture, but only a general idea of the climatic regions in which the species may occur in favourable habitats." Surely, climate alone does not govern plant distribution. For a number of orchids, and certainly for a great many other species in the flora of British Columbia, historical causes as well as local, edaphic and topographical features must fundamentally affect general and local distribution. A good many wide-ranging species of the Canadian boreal forest are "eastern" species that, for historic rather than climatic reasons, have failed to reach the Pacific Coast or central Yukon and Alaska. Conversely, several Pacific Coast species, and some of Amphi-Berigian affinity and ranges, have penetrated the interior only through gaps in the coast- and interior ranges. (Examples among the orchids are *Listera caurina*, *Habenaria unalascensis* and *H. saccata*.) Likewise, the occurrence, on high mountains far south in the Cordillera, of circumpolar arctic species, such as *Koenigia islandica*, *Phippsia algida*, *Eriophorum callitrix*, to mention only a few, must be attributed to past historical rather than climatic causes.

Calypso (Handbook 16, p. 97) is correctly noted as a "Monotypic genus found in boreal and temperate regions of North America and Eurasia". It is puzzling, therefore, to find, on page 100, *Calypso bulbosa* referred to as "the lone representative of the genus in North America", but with "relatives in Northern Europe, Russia, and Lapland, as well as in the East Indies". Among the very few typographical errors noted, *Liparis loeselli*, as a species excluded from the flora of B.C., should have been italicized in the index, on page 121.

Botanists, as well as all those with only a casual interest in the flora of British Columbia, will find these two little volumes a welcome and useful addition to the rapidly growing list of most attractive handbooks of the Provincial Museum Series.

A. E. PORSILD

Mayflies of Michigan Trout Streams

By JUSTIN W. LEONARD and FANNIE A. LEONARD, Cranbrook Institute of Science, Bulletin No. 43, Cranbrook Press, Ann Arbor, 139 pp., 82 figs., 6 pl., 1962. Paper Bound. $6.00, Cloth Bound $7.00.

Fisheries biologists, limnologists, trout fishermen, and laymen with little or no formal training in entomology will welcome the appearance of this attractive little booklet on the principal kinds of mayflies occurring in the smaller and colder waterways of the Michigan region. With the aid of twenty-five beautiful colour prints and additional photographs of adult insects and thirty remarkable black-and-white drawings of aquatic nymphal stages, the authors have exquisitely portrayed the seventy-five species (in twenty-two genera and eight families) known from the area to date. The descriptions also include information on geographical distribution, functional morphology, ecological preference, and seasonal emergence of the nymphs, and on mating and egg-laying behaviour of the short-lived adults.

Mayflies are among the most primitive existing winged insects, with a fossil record dating back nearly three hundred million years, and are the only living insects to undergo a molt in the fully winged stage. They are very important in stream ecology as a major

converter of plant to animal tissue and a principal food of stream fishes. Anglers will appreciate the information on matching of artificial flies with the more common species, and the use of common names in identification. Simplified keys to the families and genera of both adults and nymphs, and an adequate index, glossary, and list of pertinent references are provided. Particularly useful are the authors' instructions for collecting, preserving, rearing, and studying the insects, and their professional account of photographic methods and equipment. The booklet is slightly larger than pocket size, bound in a weak but artistically pleasing blue paper cover on which is delicately overprinted in yellow the outline of a male *Stenonema rubrum*. The scholarship and general format of this booklet should set a standard of excellence that will endure for some time to come.

E. L. BOUSFIELD
National Museum of Canada
Ottawa, Ontario

Native Wild Plants of Eastern Canada and the Adjacent Northeastern United States

By F. H. MONTGOMERY. The Ryerson Press, Toronto. 1962. xxxvi + 193 p., 24 colored plates + 298 line drawings. $4.95.

There is room in Eastern Canada for just such a work in the botanical field as Professor Montgomery has prepared for the use of a non-technical public. The need in other directions has been met, more or less, perhaps because it is less difficult. The thousands of plant species in the area are not of equal general interest, although the manuals, so essential to the professional botanist, treat them as if they were. The manuals are not the answer here. There are popular handbooks, not too well attuned to our area and, however correct, quite inadequate. They are, at best, only a partial answer to the need. And there is a need. Whatever the fault, pupils graduate from our secondary schools almost immunized to further botanical pursuits. The study, while of life, is not as lively as that of zoology and does not offer the same challenge of a pitting of wits. But then, even the mineral kingdom with only its lure of gold and precious jewels lurking possibly in a find, scores ahead of the lowly plant. Somehow a corrective must be found.

In this attractive volume, convenient in size for field use, much has been done to gain favor for its subject. The language is that which a field naturalist can understand. Such technical terms as must be employed, if unfamiliar, are found in a glossary at the end of the book. Instead of the rigidly stereotyped treatment of the manuals, just the attention is given to each entity that its interest warrants. Spring beauty, *Claytonia caroliniana* is described and illustrated, but its sister species, *C. virginiana* only needs to be distinguished from it. Plants of only minor amateur interest, such as the difficult sedges, are dismissed with a reference to them. Elimination applies to other sections of the flora which are adequately treated in other publications available usually at nominal or no cost—ferns, grasses, weeds, trees and shrubs. A bibliography on page 177 is a guide to these, although the cost is not given. Omissions in these categories can be disappointing, but along with restriction of the scope to plants of concern in our area only they do allow for the desired limitation of bulk.

For the use intended, indication of season, habitat and other distinguishing peculiarities is welcome. Appeal for restraint in picking orchids and trilliums (examples of rarer species and those abundant but still susceptible to extermination) is imperitive. Equal warning against picking poison ivy might have warranted its inclusion since equally shrubby plants like bittersweet and carrion-flower are not excluded.

The necessary illustration is provided chiefly by line drawings in close association with the descriptions; and also by color photographs of an appropriate selection of two dozen species; all by the author. The drawings are diagrammatic and, within the limitations of the two-dimensional, are effective.

The keys provided differ from the usual in relying more on vegetative characters. These are present whether or not the plant is in flower; and are less dependent on magnification of parts with a lens. For larger families completion of the keying is, to advantage, at these several places. The arrangement of families is in the order familiar to most in Gray's Manual. Latin and common names are those currently in use, some of the latter duplicated for local preference—outside French Quebec!

The format is pleasing and the production is in keeping with an apparent trend toward excellence regardless of cost. The older governmental policy of keeping output free or within easy reach for wide distribution would seem to be giving way to outside production. Not so sponsored, the result here is also good generally. There are instances of imperfect utilization of space, as on page 29. Page margins are sometimes invaded almost to the grief of print, see page 163. Line drawings are identified only by reference to the like numbers in the text. Rather close sequence of parts throughout contributes excusably to the compactness required for field use.

For one who got his start on Gray's *How Plants Grow* and Spotton's *High School Botany*, the present time seems replete with helps. Native Wild Plants is confidently recommended to any beginner searching out our wild flower heritage. Professor Montgomery, long at work in Waterloo and Wellington counties in Ontario as well as a wider eastern range, is fully competent and has well sensed the need of a large segment of the community.

HERBERT GROH

NOTES

Notes on Pika in Captivity

The following notes on pika, *Ochotona princeps*, were made in July and August of 1961 at the Manning Park Nature House, where a few small mammals are put on display during the summer months.

On several occasions during the past four summers rodents caged in the Nature House have produced young. In none of these cases has there been a subsequent successful rearing of the young.

On July 15 we trapped a mature female pika. Her gravid condition was not apparent, though she was examined to ensure that she was not lactating. She was taken to the Nature House and put on display in a standard 48″ x 15″ x 15″ glass cage. Throughout her stay she was kept supplied with fresh foliage consisting of clovers, usually with *Fragaria*, *Achillea*, *Lupinus* or *Taraxacum*.

At about 8 p.m. on July 19 the pika gave birth to three young, one of which was stillborn. No special steps were taken to promote a successful rearing for we expected to find the young dead by morning.

On July 20 the young were still active so the cage was not cleaned but a corner was filled with soft cotton.

At birth the young were densely furred with short blackish hair. They frequently made high-pitched chirping sounds, and almost at once were capable of crawling several inches from the nest. They were quickly retrieved from these trips by the mother who carried them by the scruff of the neck.

On July 22 we concealed the nest corner with a group of flat rocks. Daily cleaning of the interior of the cage began on July 24 without any apparent effect upon the activities of the female.

By July 27 both young had some adult hair. They had become more active, but less inclined to stray from the nest.

On the morning of July 29 both young, now almost 10 days old, opened their eyes for the first time. The following morning they made their first real exploring trip away from the nest corner, moving about the cage for almost an hour. On following days an increasing amount of time was spent away from the nest, but it remained their base of operations until about August 5.

On July 31 the young were first observed taking nibbles from foliage supplied by the mother. It appeared that weaning commenced about this date, for the mother's actions in thrusting away the young, and the cries of the young, indicated that they were not being milk-fed as often as desired. At this date the young were estimated to be nearly half as long as the mother, and roughly one-fifth her volume.

Until about August 18 the young continued to make periodic attempts to obtain milk, but with no apparent success. Their diet from early August was the same foliage mixture supplied to the adult. From the time they started to eat solids there was no observable difference in their choice of food from that chosen by the adult.

We noted that pikas produce two distinctly different types of feces. One is the small round pellet, accumulations of

which are easily found on the rock slides where these animals occur. The other is soft, roughly cylindrical, tapered at each end, and about 1¼ inches long by 3/16 inches in diameter. Although I was not aware of it at the time, these two kinds of feces are known for several kinds of rabbits (H. V. Thompson and A. N. Worden, 1956, *The Rabbit*, Collins), and the larger type is reingested to the nutritional advantage of the animal. Actual reingestion was not observed for pikas.

In most animals caged in the Nature House we are able to recognize behaviour patterns apparently associated with the animals' confinement. In the present instance the female pika early adopted the custom of plucking nervously and rapidly with her teeth at the wire mesh of the cage bottom. Usually she chose the centre of the cage for this activity, and she frequently carried a length of plant stem across the back of her mouth through part or all of this performance. After about August 20 the young were sometimes seen in the same activity, perhaps in imitation of their mother.

By August 25 the young had attained a volume estimated at half to two-thirds that of the mother. They were well furred and fat, apparently in good health. On most mornings they indulged in active play periods, leaping and dashing about the cage.

We found the pika to be an unusually good cage animal, easy to care for, easily tamed, and in being mainly diurnal, a good animal to put on public display. There would seem, also, to be some possibility of using it successfully as a laboratory mammal.

The author would like to acknowledge the assistance of Mr. R. Y. Edwards in the preparation of this note.

J. E. UNDERHILL

Parks Branch
Dept. of Recreation & Conservation
Victoria, B.C.
5 February 1962

Breeding Record of the Field Sparrow in Manitoba

ON JUNE 30, 1960, near Winnipeg, the writer flushed a small dark sparrow from a grassy clearing in a tract of second-growth aspen. I was unable to get a clear view of the bird which appeared very nervous and remained low in the grass. A short search of the area from which the bird flushed revealed a nest containing two eggs. One of the eggs was that of a Cowbird, *Molothrus ater*, the other was smaller with a pale green ground colour and finely spotted with reddish-brown.

Observations on July 1, 2 and 3 convinced me that the bird was a Field Sparrow, *Spizella pusilla*. It was on July 3 that a clear view of the bird was obtained and the characteristic field marks of the species noted. On July 6, Mr. Angus H. Shortt saw the bird and confirmed identification. Further confirmation was obtained when Mr. R. W. Sutton, Director of the Manitoba Museum, saw the bird on July 14.

On July 6 the Cowbird egg hatched and the nestling was fed and brooded until July 15 when the nest was found empty. The sparrow egg never did hatch and on July 14 it had been collected. Subsequent examination by Mr. Sutton showed it to contain a desiccated embryo about 6 days old.

The above observations constitute the first recorded breeding of the Field Sparrow in Manitoba.

HAROLD V. HOSFORD

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Charleswood 20, Manitoba
2 April 1962

A Short-tailed Albatross off British Columbia

ON JUNE 11, 1960, an immature Short-tailed Albatross, *Diomedea albatrus*, was sighted and photographed in the Pacific Ocean within 40 miles of Vancouver

Island, British Columbia. This observation was made from the Canadian research vessel, C.N.A.V. Oshawa, engaged in an oceanographic survey (Lane, Meikle, and Hollister. 1960. Fisheries Research Board of Canada MS Report Series, (Oceanography and Limnology), No. 76).

The subject was present within a group of the common Black-footed Albatross, *Diomedea nigripes*. Identification was based upon the large pink bill, the pale feet, the size (larger than the Black-footed), and it's raucous attacks upon scraps thrown overboard.

The identification was confirmed, from the color photograph, by the British Columbia Provincial Museum. Information from the Museum (PC: D. J. Guiquet, June 23, 1960) and from Pough (1957, *Audubon Western Bird Guide* Doubleday and Co., Garden City, N.Y.) indicates that it is somewhat of a rarity. By 1933, feather exploitation and the volcanic eruption of the breeding island were thought to have rendered the bird extinct. However, in "recent years" (Pough, 1957) some 20 birds have returned to breed. The last British Columbia record of this species was in 1898.

More recently, another sighting has been claimed off the Oregon coast (Wyatt, Oregon State University, Department of Oceanography—in preparation).

ROBERT K. LANE

Department of Oceanography,
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9 February 1962

Gannet population of Bonaventure Island

DURING A VISIT to Bonaventure Island, Quebec, from July 10 to 13, 1961, I made an estimate of the breeding population of the Gannet, *Morus bassanus*.

The breeding population of Gannets can be divided into two groups, one breeding on ledges on the cliffs and the other breeding on the top of the island. All the cliffs on which Gannets were breeding were photographed from the sea. The counts of the birds on the ledges were made from the negatives using a low-powered microscope with a ruled eyepiece. No difficulty was encountered in distinguishing Gannets from other seabirds, but often the Gannets themselves were grouped so close together that counting was made difficult. Several groups of non-breeding Gannets at the base of the cliff were excluded from the count.

Two methods of counting were used for the Gannets breeding on the ledges. The first was counting all the Gannets, then multiplying this figure by the ratio of birds to nests. This ratio was obtained by counts from the tops of the cliffs looking down at certain convenient points. The ratio of birds to nests was found to be 100:77. Using this method, the cliff-breeding population was calculated as $8200 \times 77/100 = 6300$ pairs. The other method was suggested to me by James Fisher and consisted of counting the number of apparently occupied nests directly from the photographs, making judgment during counting as to whether two birds close together were nestmates. After a little practice, starting with those photographs taken at the least distance, this method seemed to work well. The count obtained by this method was higher, probably because in using the previous method nestmates had been, in some cases, counted as a single bird. The count by the second method was 6800. Before any final conclusion can be made the two methods would have to be used on a colony of known size, but the second method appears the more reliable.

On the top of the island groups of a few hundred were counted. These groups were then used as units for estimating the population of the colony. This estimation was checked by counts from photographs for some of the colony. There was generally a line, two

or three deep, of birds without nests on the edge of the colony. These birds, totalling about 800, were excluded from the count. The ratio of birds to nests was found to be 100:75. The number of nests on the cliff tops was 8600 x 75/100 = 6450.

The total number of nests was thus estimated at 13250 (6800 on the ledges of the cliffs and 6450 on the top of the island). This shows that there has been a considerable increase since 1940 when the total population was estimated at 6680 (Fisher, J., and H. G. Vevers, 1943, Journal of Animal Ecology 12:173-213).

DAVID B. PEAKALL

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Syracuse, New York.
19 February 1962

Northward Dispersion of Banded Canada Geese

THIS NOTE CONCERNS an apparent premoulting, northward migration of prairie-raised Great Basin Canada Geese, *Branta canadensis moffitti*, into the subarctic regions of the District of Keewatin, Northwest Territories.

During the period June 16 to July 25, 1960, my assistant and I carried out preliminary field studies of interrelations between barren ground caribou and wolves. Our field camp was located on the shore of the Thelon River about 175 miles west of Baker Lake, Keewatin. On June 19 we were canoeing several miles upstream from camp, at approximately 101° 48' W, 64° 21' N. Moulting and premoulting Canada Geese, unable to fly very far, were seen in many places on the river or feeding on the grassy vegetation along the shore. Usually the geese would avoid the approaching canoe by swimming out into the river. Once, however, a trio of large Canada Geese elected to run inland, directly away from the river. My Labrador retriever had been running along on the shore, and immediately set off in pursuit when she picked up the fresh scent. Several minutes later the dog returned with one of the geese. The bird carried United States Fish and Wildlife Service Band number *518-45560*. After recording the band number I released the bird into the river.

From correspondence with the Canadian Wildlife Service and United States Fish and Wildlife Service I learned that the bird was banded on June 23, 1957, at Bowdoin National Wildlife Refuge, Malta, Montana. It was recorded as a flightless male bird of the year. The recovery site is ten degrees east of north in relation to Malta, Montana, at a distance of approximately 1,150 air miles from the Bowdoin Refuge.

Although I saw several hundred of the "large-type" Canada Geese during the summers of 1959 and 1960, I did not see any nests or young. However, Clarke (1940, National Museum of Canada Bulletin 96:1-135) found broods, and Hanbury (1904, *Sport and Travel in the Northland of Canada*, not seen *vide* Clarke, *op. cit.*) located nests of Canada Geese on the upper Thelon. Specimens taken there by Clarke were referred by P. A. Taverner to *B. c. leucopareia*, a smaller type Canada (Clarke *op. cit.*). According to Delacour (1954, *The Waterfowl of the World*. Vol. I), the Thelon River is in the breeding range of the Lesser Canada Goose, *B. c. parvipes*, and local breeders may be all of this subspecies. The area which we investigated near our campsite was mainly used by non-breeding large Canada Geese.

There is also evidence of a much longer northward flight of non-breeding Canada Geese. On July 14, 1960, I observed amongst a small group of fourteen large Canada Geese two individuals carrying 2½- to 3-inch wide yellow neckbands. A week later another Canada Goose was seen carrying a blue neckband. Both observations were made within twelve miles of the point of capture of the leg-banded bird.

According to Canadian Wildlife Service records, authority to use blue and yellow neckbands on Canada Geese was given by the United States Fish and Wildlife Service to the Lower Souris National Wildlife Refuge (blue bands) and the Missouri Conservation Commission (yellow bands). Both studies were to be terminated in 1959. The New Mexico Department of Fish and Game was authorized to use both yellow and blue neckbands on Canada Geese in a study which was to be completed on March 31, 1959.

Although no positive proof is available, I suggest that the neckbanded geese that I observed were banded in New Mexico. Blue and yellow neckbanded birds are frequently observed on the Bowdoin National Wildlife Refuge and these were proven to be banded by the New Mexico Department of Fish and Game in the Rio Grande Valley, some 1,075 miles to the south of Bowdoin. (Refuge Manager B. N. Carter, *pers. comm.*).

I surmise that the leg-banded Canada Goose travelled from the Bowdoin Refuge to the Rio Grande Valley, New Mexico, as that is the traditional wintering area (Carter, *op. cit.*). After wintering there the bird may, during any of the next three seasons, have associated with geese which summer in the Thelon. The flight northward from the Rio Grande is more than 2,200 air miles.

Delacour (*op. cit.*) mentions the great summer wandering of non-breeding Canada Geese as a general group characteristic. Therefore, the presence of numbers of large-type Canadas on the Thelon may be a recent phenomenon, which could be attributed to the increasing drought conditions on the traditional moulting areas of the U.S. and Canadian prairies or a population increase in the Great Basin Canada Goose. Further investigation may reveal that such pre-moulting flights of non-breeders into the subarctic are, or will become, part of a yearly pattern for this subspecies.

In this connection Cowan (1954, Murrelet 35(3):45) has recorded two specimens of *moffitti* banded as juveniles in southern British Columbia which were later recovered in the Bathurst Inlet area, Mackenzie.

I am grateful to Mr. A. Dzubin for critically reviewing the material contained in this note.

E. KUYT

707 Dufferin Avenue,
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13 May, 1962

The Silver Spotted Skipper at The Pas, Manitoba

THE SILVER SPOTTED SKIPPER, *Epargyreus clarus* Cramer (Lepidoptera), though common throughout the eastern United States, is indeed a great rarity at the latitude of The Pas, Manitoba. I was consequently greatly surprised to see it netted by Frank Chermock who was at the time visiting the writer at The Pas (July 7, 1961). The event took place some miles north, up the road from the Indian Cemetery, on the hill, at Big Eddy, overlooking Pike Lake.

The specimen was flying together with such local things as *Papilio machaon hudsonianus*, *Boloria dawsoni*, *Colias gigantea* and *Hesperia borealis?* along the roadside. All these, except the *Hesperia*, which settled on the gravel of the road, were going to dog-bane, *Apocynum andromaesifolium*, then heavily in flower since about July 1.

The *Epargyreus*, though not saved (Chermock thought it common locally and so released it!), was a somewhat worn male specimen and is certainly a migrant. No others were seen throughout the entire summer's collecting at The Pas and no other specimens are known from The Pas area, even though the author has collected there now for thirteen years. The species belongs to the fauna of the central eastern and southern United States and extends southward into South America.

I am indebted to Paul and Frank Chermock for netting the specimen and so drawing attention to its presence at the rather northern latitude of 53°N at The Pas, Manitoba.

WALTER KRIVDA

Park Naturalist
Riding Mountain National Park, Manitoba
29 July 1962

The Small-mouthed Salamander, New to the Fauna of Canada

IN THE COURSE of examining collections of salamanders of the *Ambystoma jeffersonianum* complex at the University of Michigan Museum of Zoology and Royal Ontario Museum, two specimens of the Small-mouthed Salamander, *Ambystoma texanum* (Matthes), from Pelee Island, Essex Co., Ontario, were discovered. These two specimens are the basis for an addition to the faunal list of Canada.

One of the specimens, UMMZ 52195, was collected by A. G. Ruthven, July 6 or 7, 1917. It and other salamanders were taken from logs at the south end of the island. The specimen is an immature female, 27 mm. from tip of snout to posterior end of vent.

The second specimen, ROM 8094, was collected by A. Reid, June 6, 1950. It is a mature female, 70 mm. snout to vent.

These specimens were both removed from series of salamanders identified as *Ambystoma jeffersonianum.* I have examined eight specimens of the *A. jeffersonianum* complex, four males and four females, from Pelee Island. They are *Ambystoma laterale.* Mature males are from 45 to 61 mm snout to vent, mean 53.7. They are considerably smaller than the size range (70-90 mm) indicated by Minton (1954, Herpetologica 10: 173-179) for *Ambystoma jeffersonianum.* They are dark, almost black, except when faded whereas most preserved specimens of *Ambystoma jeffersonianum* are gray-brown.

The specimens of *Ambystoma texanum* differ from the specimens of *Ambystoma laterale* in lacking lateral patches of vomerine teeth, in having the plicae of the tongue forming a distinct groove, in having the mandibular, maxillary, and vomerine teeth in two more or less well defined rows, and in having 13 rather than 12 costal folds between the fore and hind limbs.

Specimens of *Ambystoma texanum* are known from some of the Lake Erie islands of Ohio. None have been taken on the north shore of Lake Erie.

I wish to thank E. B. S. Logier for permitting me to examine the Royal Ontario Museum (ROM) specimen.

THOMAS M. UZZELL, JR.

University of Michigan
Ann Arbor, Michigan
13 June 1962

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CHANGES IN THE DISTRIBUTION OF THE SNOWSHOE HARE IN SOUTHERN ONTARIO

Antoon de Vos
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Near the limits of an animal's distribution there is often a marginal zone in which the species exists in low numbers. This is attributed to environmental conditions becoming increasingly marginal as the range boundary is approached. Since snowshoe hare populations seemed to be reduced near the range boundary, efforts were made to obtain further data about the actual distribution of the species along its southern range boundary and about environmental factors prevailing in and around the areas inhabited by hares. This paper deals with a description of the past and present status of snowshoe hares (*Lepus americanus* Erxl.) in southern Ontario, while another paper will discuss the influence of environmental factors on the status of the species in more detail (de Vos, Austin and Mason, MS).

Since pioneer days, the snowshoe hare has disappeared from many parts of the east and mid-west as a result of clearing forests for agricultural land. In the Great Lakes area this has resulted in a recession of the range northward.

In Michigan snowshoe hares were once found over the entire state, but they are now restricted to an area north of a line west of Saginaw Bay (Burt, 1948). In Wisconsin, the species formerly occurred in favorable habitats in the central and southeastern parts of the state. The south boundary did not retract further in a northerly direction after 1930 (Leopold, 1947). It now runs through the center part of the state, although hares are absent also from the counties along the Wisconsin River.

Several papers refer to the early status of the snowshoe hare in Ontario. These include those written by Brooks (1905), Clarke (1944), Fleming (1913), Snyder (1930) and Soper (1923). Much information about the biology of the species is contained in the paper by MacLulich (1937). Peterson (1957) describes changes in the mammalian fauna of Ontario.

The southern boundary of the snowshoe hare in Ontario has been gradually receding northward over the past half century or more. It seems likely that before white settlement started the species was present throughout most or all of southern Ontario where it was a resident mainly of evergreen swamps (Saunders, 1932). In Figure 1, various locations are indicated where these hares were present after the turn of the century, but had disappeared

Mailing date of this number: January 7, 1963

before 1931. Further, the southern boundary is shown as it was considered to be about 1931. Hares were then absent from large sections along the north shores of Lake Erie and Lake Ontario. Finally, the distribution is given for the year 1961.

Data regarding the distribution of snowshoe hares in southern Ontario were obtained from personnel of the Ontario Department of Lands and Forests, from other individuals who had knowledge of the situation, from the literature, and questionnaires of the Royal Ontario Museum covering the period 1931-34. These data were screened as much as was possible for their validity. Letters reporting various observations are on file in the Department of Zoology of the Ontario Agricultural College. Since 1953 the author and various students visited numerous swamps within a driving distance of forty miles from Guelph to ascertain the presence of snowshoe hares.

STATUS DURING THE 1930'S

Hares were reported absent during the 1930's from the following counties: Essex, Kent, Lambton, Elgin, Haldimand, Welland and Lincoln. Apparently in the 1920's Wainfleet Swamp west of Welland was still frequented by a good population. Hares became extinct in Welland County around 1929 (R.O.M. records).

The species was considered very scarce or locally present in the tier of counties including Middlesex, Oxford, Norfolk, Brant, Wentworth, Halton, Peel and York. W. E. Saunders (1934) reported that there were almost no hares within a fifteen mile radius around London. According to C. H. D. Clarke (*pers. comm.*) hares were very numerous in 1921 in the Komoka Swamp, situated about 20 miles west of London. Hares were also present in Dorchester Swamp, east of London in the 1920's (H. Zavitz, *pers. comm.*). The last hare recorded for the southern part of Norfolk County was killed in 1932 in Charlotville Township (Hall, *pers. comm.*). While hares were still common in the northern part of Oxford County in 1934, they were rare (R.O.M. records). The only two places where hares were recorded to occur in Brant County in 1931 were Burford Swamp and Lynden Swamp. The main stronghold for hares in Wentworth County was Beverley Swamp. In Halton County, hares were absent from the southern one-third. In Peel County snowshoe hares were still abundant in 1931 around Caledon, rare north of Brampton and absent south of there. In York County hares were absent within a fifteen mile radius from the city limits of Toronto, but still common in the central and northern parts of the County.

In the tier of counties north of those discussed, hares were still locally abundant mainly in isolated swamps, but they had disappeared from the urban and intensely cultivated agricultural areas. In Huron, Perth, Waterloo, Ontario and Durham counties, hares were absent or rare in the southern parts, but still locally abundant in the northern parts. In Durham County, north of the village of Hampton, hares were abundant in the mid-twenties in a cedar swamp (A. E. Allin, *pers. comm.*). In Northhumberland County, hares had also become quite scarce due to much hunting (O. E. Kelly, *pers. comm.*).

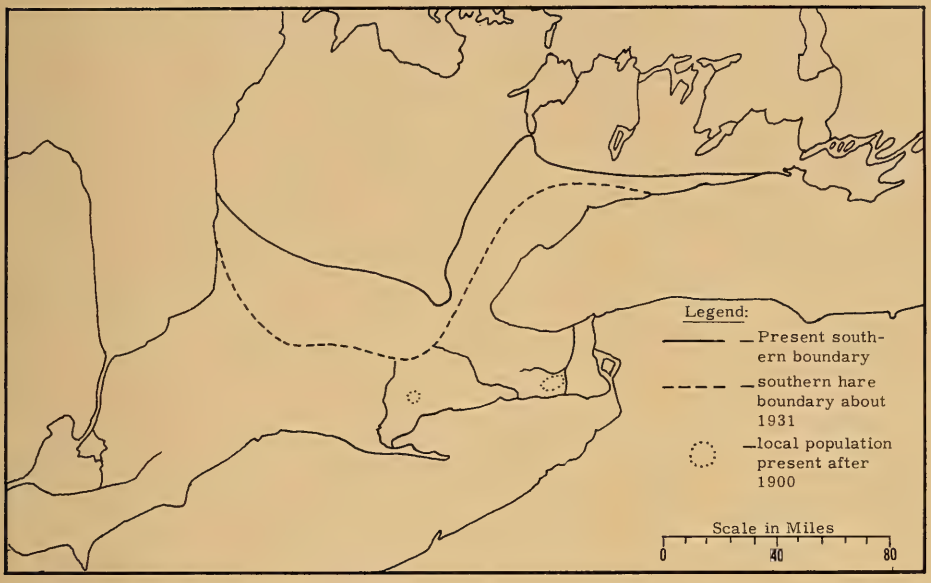

Figure 1. The present and past distribution of snowshoe hares in southern Ontario.

In Prince Edward County hares were scarce. On February 12, 1937 one track was seen in a swamp near Hillier and during the winter 1936-7 six hares were reported shot (Snyder, 1941).

Status, period 1940-1950

It appears from data obtained regarding the distribution of the snowshoe hare covering the period 1940-1950 that the range continued to shrink, although more gradually than during preceeding decades.

In Waterloo County, a few hares remained in the Philipsburg area near New Hamburg (Nith Valley Conservation Report, 1951). In the winter of 1939-40, a few hares were seen and shot in the Roseville Swamp, a few miles west of Galt (P. C. Hilborn, *pers. comm.*). In Wellington County, a few hares were shot in Puslinch Township in the southern part of the Township (Wm. Steele, *pers. comm.*). In Brant County two hares were shot in 1950 in Oakland Township, Concession IV. No reports could be obtained of observations in York County south of Newmarket since about 1949.

Status, period 1950-present

A reduction of range of the snowshoe hare took place at a slower pace than during the period 1940-1950, and apparently consisted mainly of a few small populations becoming extinct in isolated swamps. The first account of a spread in range comes from Prince Edward County where hares have been observed in at least three isolated colonies since the winter of 1960-61 (Depart-

ment of Lands and Forests records). Reference will be made to a few observations made in places where hares were considered rare.

In the nothern part of Waterloo County few hares survive in Wellesley and Woolwich Townships (Report of Department of Lands and Forests). A few hare tracks were seen by A. de Vos in Beverley Swamp, Wentworth County on February 21, 1956. A few hares survive in isolated woodlot areas in the northern part of York County (D. Johnston, H. Van Wyck, *pers. comm.*). Mr. J. J. Armstrong saw what he considered a snowshoe hare track in a swamp in Oakland Township, Brant County, on February 27, 1960. Mr. Harold Reeve (*pers. comm.*) reported two isolated populations in Durham County south of highway no. 2 in 1955. Mr. F. M. Helleiner (*pers. comm.*) observed one hare two miles north of Glen Major in Ontario County on January 22, 1950. In 1958, J. Catcher reported one shot in Caledon Township, Peel County.

During recent years, as was the case during previous decades, snowshoe hares are uncommon or rare along the southern boundary of the species. The distribution is scattered, and hares are mainly restricted to poorly drained or swampy areas in which there is heavy coniferous cover. Stands of white cedar, black and white spruce, or a mixture of these, appear to offer the most suitable habitat.

In order to obtain a clearer picture of the recent distribution of the species along its south boundary, large swampy forest areas in the southern and central part of Wellington County were searched systematically for the presence of snowshoe hares. In Figure 2 are shown the various locations which were visited between 1952 and 1958. The location, vegetation, size of the area, and the presence of hares were recorded on each visit. Of the sixty-seven locations visited twenty-two did not contain hares. The areas which did not contain hares were generally more open and contained predominantly white elm, trembling aspen, willows and red maple, although some also consisted largely of mature white cedar, spruce or hemlock. Several woodlots, overgrazed by livestock, did not contain hares. A glance at Figure 2 shows how discontinuous the distribution of hares is in the southern part of the County.

Snowshoe hares fluctuate in numbers at fairly regular intervals attaining a relatively high abundance every nine to eleven years (MacLulich, *op. cit.*). During periods of abundance certain individuals will egress from their preferred habitat which may initiate either a permanent or a temporary extension of range, depending on environmental conditions in the newly occupied range.

It appears that man's activities in modifying the habitat have produced the necessary change to eliminate hares.

Reasons for the reduction in range of the species in southern Ontario include drainage and other man-made changes in the vegetation of swampy areas. Particularly the removal of white cedar, but also to a lesser extent of other conifers, has had an influence on diminishing suitable range conditions. Other reasons are depletion of suitable food and cover by overgrazing of livestock and overshooting of isolated populations of hares.

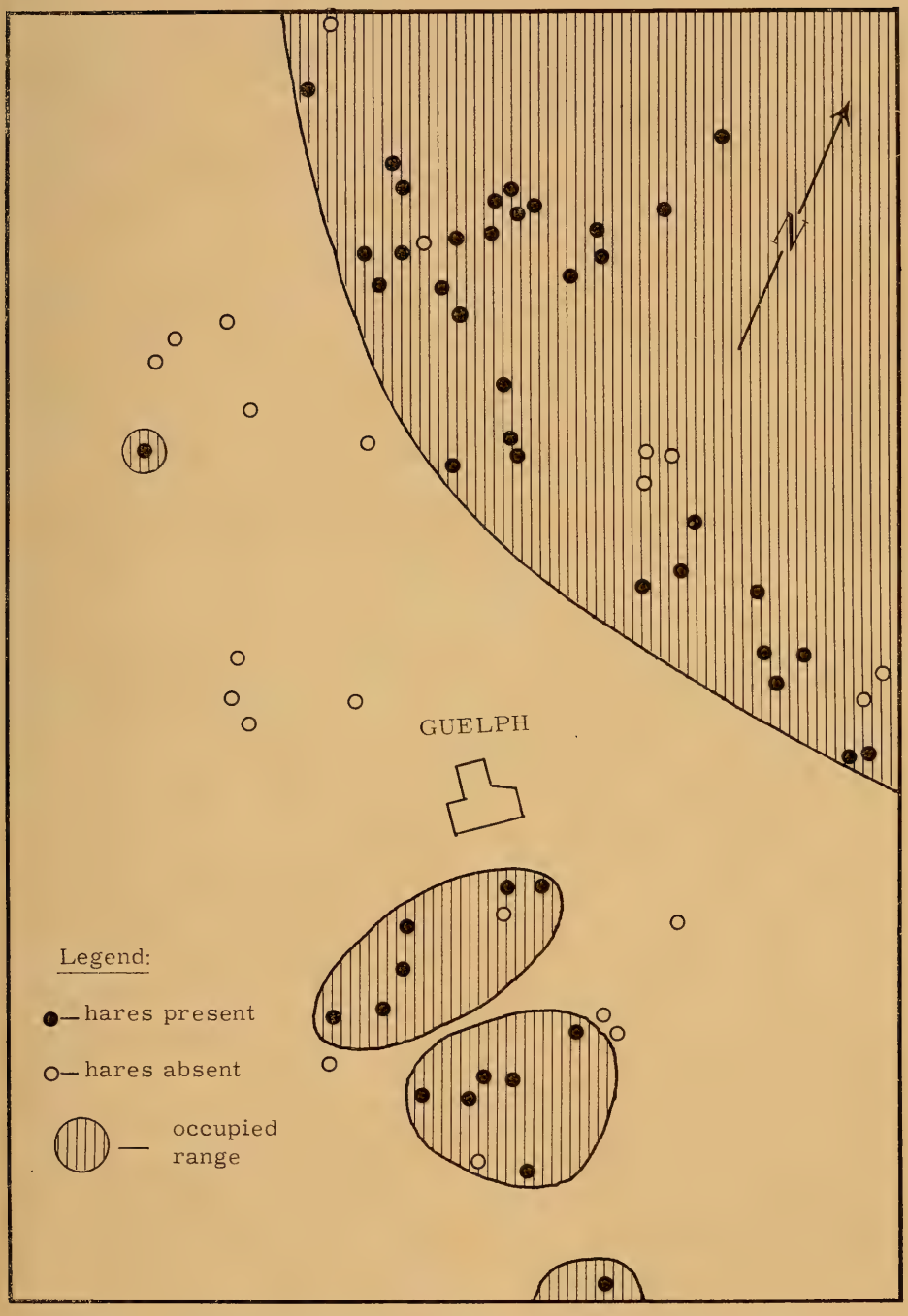

Figure 2. Distribution of snowshoe hares in the vicinity of Guelph, Ontario, 1960. Scale 1 inch = approximately 5 miles.

Reforestation efforts during recent decades and farm desertion may change the trend reported on in this paper. Recent evidence indicates that some reforested areas in the Lake Simcoe Forest District are being re-occupied. Thus there is no stable southern limit to the distribution of snowshoe hares, but rather it is fluctuating within a marginal zone. Occupancy of habitat can be favourably or unfavourably altered by man's activities.

Summary

Changes in the distribution of the snowshoe hare are described for southern Ontario, covering the period 1930 to the present. The species has receded in range in a northerly direction during that period. Reduction in range may have come to a halt and there is some evidence that limited range extension is taking place, particularly where reforestation and farm desertion is in progress. Reasons for reduction in range include drainage and changes in the vegetation of swampy areas by logging and overgrazing by livestock, as well as overshooting of isolated populations. Occupancy of habitat can be favourably and unfavourably altered by man's activities.

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NESTING OF THE YELLOW RAIL IN SOUTHWESTERN MANITOBA

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On June 11, 1962, I flushed two Yellow Rails, *Coturnicops noveboracensis*, from the edge of a boggy area, about two miles from the city of Brandon, Manitoba. This type of wetland is known in western Canada as "buffalo-wallows", and is usually in the form of a regular succession of grassy hummocks and water-filled depressions. As this was the first time I had ever encountered this rail, after more than forty-five years of birding in the Brandon area, I determined to research the species. I was aided in this work by a house guest, Oscar M. Root, of North Andover, Massachusetts.

By June 22 I had found four areas each of which harbored one pair of Yellow Rails. These four locations were within one mile or less of each other, and all were subjected to thorough searches for nests, during the last part of June and the first two weeks of July.

I chose Area Two for the first search, since the spot is by far the smallest, about 1½ acres in extent, and has very little willow or other concealing growth in it. I entered this expanse of sedgy humps-and-hollows early in the morning of June 17, and at 9:30 found my first nest of the Yellow Rail. Angus H. Shortt, of Winnipeg, Manitoba, tells me that this is Manitoba's first recorded nest of this species. Containing four eggs, it was sunk into the crown of a low hummock, was made entirely of dead grass, had a canopy of last year's sedge grass overhanging it, and was further hidden by the growth of new, green, sedge grass. Only the glint of sun on eggs betrayed the nest.

The nest-hummock was surrounded by eight inches of water, and the small opening into the nest was only several inches above water-level. The

external diameter of the nest was 5½ in.; the internal diameter, 3½ in.; the inside depth, 3 in. By June 24 no more eggs had been added and incubation was evidently under way. On June 26 I found that a high wind had sifted debris into the nest, partially covering the eggs, and it was apparent that the female rail had abandoned her nest. This desertion must be blamed on human interference.

Area One—where the species was first seen—was subjected to several intense searches without success. This terrain has an expanse of about 3 acres, with a few willows scattered about the edge, but much the same character as Area Two. Indicating the thoroughness of the hunts for a nest at this location, nests of Northern Yellowthroat, Sharp-tailed Sparrow, and Common Snipe were found as by-products of the search. The loud, rapid, "*Tic-tic, tic-tic-tic*" call of the Yellow Rail was always present during the earlier searches, but entirely lacking in the later hunts. I never heard this call come from more than one spot at once, and assume that only the male gives it.

I gave Area Three a good combing on three occasions, the last two with Mr. Root as a companion, but here again no nest was found, although the ticking call was heard constantly during the first two searches. This is an area of quaking bog, about 2½ acres in extent, and is bordered on three sides by willows, with a few others growing out in the bog.

Area Four is another quaking bog, and it is spring-fed. I first heard a Yellow Rail here on June 22 and found the nest on July 2, with only one egg. By July 10 the full clutch of nine eggs was laid. I visited the nest several times during incubation and found the eggs arranged in three rows of three, except that one visit revealed one egg on top of the other eight. This was the only instance of 'piling' noted. Hatching occurred on July 23, so the incubation period was 13 days, assuming incubation to have started only after the last egg was laid. Terrill (1943) believed this to be the case.

The following notes on this nest and its location are furnished by Oscar M. Root:

"The nest was sunk into the crown of a hummock, about six inches above the water, which was only two inches deep at this spot. Both old and new sedge were present in profusion. Young shoots of hoary willow (*Salix candida*) grew out of the hummock on two sides of the nest, and again a canopy of dead sedge had been so skilfully arranged as a screen that only a most searching look could penetrate to the nest. The bog, of the usual buffalo-wallows type, is about two acres in size and is surrounded by willows, with others up to ten feet in height occurring in numbers throughout the bog.

"Other nesting species found in some or all of the four areas included Red-winged Blackbird, Short-billed Marsh Wren, Sora Rail, Northern Yellowthroat, Sharp-tailed Sparrow, Common Snipe, Bobolink, and LeConte's Sparrow."

Following the desertion of the first nest, Mr. Root and I returned to Area Two on July 4, to search for another. To our amazement we found a new nest in the same hummock from which we had removed the first nest, after the desertion. Since much of the sedge growth had been taken when we

lifted the original nest, this second effort was very poorly hidden, the overhead cover being especially scanty so that the lone egg was in plain view. We left this nest strictly alone until July 11, when a return visit revealed just the one egg there, the hen quite evidently had abandoned this second attempt, and the absence of call-notes from the male indicated that the pair had left the area. It is worthy of note that, on the evening of July 9, the male Yellow Rail in this area was heard to call incessantly from a spot about 200 yards from the buffalo-wallows, in a region of heavy marsh-and-prairie grass growth. I am inclined to believe that that day marked the crisis in the affairs of this pair, and from then on, the area was silent.

I have reached the following conclusions on the breeding activities of the Yellow Rail:

The birds appear to be mated on arrival. Not more than one pair inhabit a given area. Only the male calls. The calling stops when the young are born. This call can be heard at least one-third of a mile on a quiet evening. During the incubation period the male is very alert, and it is impossible to approach the nesting area without the ticking starting up—a warning to the sitting female. Since at least one bird was flushed into full view from each of the four areas, and bearing in mind the very great distance the calls can be heard, I believe this is a much easier species to locate than the Virginia Rail, for instance. The female Yellow Rail is second to none in her ability to hide her nest. Incubation period is 13 days, plus a few extra hours in the case of the final egg. Once hatched, the young rails join their parents in maintaining a complete silence. This species must be considered quite nomadic when seeking a breeding location.

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RECENT BIRD NOTES FROM THE BLUE SEA LAKE AREA IN QUEBEC

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A PAPER ON THE summer birds of Blue Sea Lake was published by the writer (Gabrielson, 1938) and subsequently some supplementary information covering the time spent in this area from 1938 to 1947 inclusive was printed (Gabrielson, 1949).

Since that time I have been in the Blue Sea area nearly every summer up to and including 1961. I have visited most of the other lakes, marshes, fields, and forests covered in the earlier reports though not as extensively as in the earlier years. Obvious changes in bird populations have taken place, some of which appear to be clearly associated with ecological changes; in others the relationship is not at all obvious if indeed they are at all connected with local ecological patterns.

Among the water birds loons and Common Mergansers have shown a marked decrease especially on Blue Sea Lake itself. There has been a considerable growth of human use of the shores and islands on which these two species formerly nested which could account for this change in numbers.

Since 1948 Ring-necked Ducks have been completely absent from the small ponds on which they formerly bred; although I can see no obvious ecological change nor any change in human use of the lakes or the adjacent shoreline. All of the emergent and submerged acquatics that were common years ago are still present though there may be differences in their relative abundance.

On the other hand Pied-billed Grebes, Black Ducks, Hooded Mergansers and Ring-billed and Herring gulls are more numerous both on Blue Sea Lake and the adjacent lakes which I visit regularly.

There has been no obvious change favorable to the grebes, Black Ducks or Hooded Mergansers that would account for their increased abundance but the fact remains that both individuals and the number of broods seen have increased.

There is no gull colony known to me in the territory regularly worked and the build-up in the number of individuals in late July and August indicates a considerable post-breeding movement into the territory.

Until 1947, three to six Herring gulls were the usual number present while since that time the species has been more regular and in some years, notably 1959, more numerous.

The Ring-billed Gull was not noted until 1953 and has been the most numerous water bird since about 1956.

Among the land birds the following species have been noticeably less numerous since 1948: Bald Eagle, Osprey, Bluebird, Red-eyed Vireo, Black-and-white Warbler, Magnolia Warbler, Black-throated Blue Warbler, Chestnut-sided Warbler, Ovenbird, Canada Warbler, Redstart, and Indigo Bunting.

The reduction in the number or the frequency of observation of the Bald Eagle, Osprey, and Bluebird are perhaps associated with the widely reported decrease of these species, the reduction in Magnolia and Chestnut-sided Warblers and Indigo Buntings in the territory studied is probably due to obvious vegetative changes that have taken place; but I am not able to associate the lesser numbers of Red-eyed Vireo, Black-and-white Warbler, Black-throated Blue Warbler, Ovenbird, Canada Warbler or Redstart with any significant vegetative changes in the areas they have always occupied. All these forms are present but in smaller numbers.

On the other hand the Red-shouldered Hawk, Broad-winged Hawk, Barred Owl, Nighthawk, Blue Jay, Raven, Nashville Warbler, Bay-breasted Warbler, Blackburnian Warbler, Cowbird, Red-winged Blackbird, Evening Grosbeak, and Purple Finch have increased. The two hawks and the Barred Owl may have extended their breeding range to include this local area and the Evening Grosbeaks certainly have done so. I am not able to give any logical reason for the upswing of some of the woodland warblers that utilized much the same habitat as some of those that have decreased markedly in recent years.

The following species accounts bring up to 1961 the more noticeable changes that have occurred since 1947.

Gavia immer (Brünnich): Common Loon

Noticeably less abundant on Blue Sea Lake and on many of the neighboring lakes.

Podilymbus podiceps podiceps (Linnaeus): Pied-billed Grebe

Much more frequently seen and more numerous on several lakes, marshes and ponds especially in 1949 and 1953.

Anas rubripes Brewster: Black Duck

Definitely more abundant since 1949. Greatest numbers of broods and individuals seen in 1953 and 1955 but it has been more common until 1961. In that year the number of broods dropped considerably.

Mareca americana (Gmelin): American Widgeon

On July 31, 1952, a female with five partly-grown young were seen on a little lake just north of Lake Baskatong. This is the only record for the species.

Aythya collaris (Donovan): Ring-necked Duck

I have not seen a single individual of this species since 1948.

Bucephala clangula americana (Bonaparte): Common Goldeneye

One of two birds was collected on Blue Sea Lake on October 4, 1951, and a female with four young was watched for some time on a small wooded lake near the Lapine Depot on the Gene de Terre River.

Lophodytes cucullatus (Linnaeus): Hooded Merganser

This bird has become more numerous as the Common Merganser has decreased. It is now second in numbers to the Black Duck among the waterfowl. Broods seen nearly every season since 1949.

Mergus merganser americanus Cassin: Common Merganser

Greatly decreased as a breeding bird on Blue Sea Lake and some decrease on adjacent lakes. Formerly two or more broods were seen regularly on Blue Sea but in recent years the sight of a brood excites comment.

Accipiter gentilis atricapillus (Wilson): Goshawk

A single bird at Lapine Depot July 31, 1952; a bird near Ellard Island on Blue Sea Lake on July 30, 1954; and another individual at the north end of the same lake on August 18, 1954.

Buteo lineatus lineatus (Gmelin): Red-shouldered Hawk

This species is seen more frequently since 1949. One or more birds are seen several times each season about Ellard Island and Sheep Islands in Blue Sea Lake. Occasional birds have been seen on other lakes since 1950.

Buteo platypterus platypterus (Vieillot): Broad-winged Hawk

This species bred on Big Island in 1947 and in several subsequent years I have seen newly fledged young on the island. In addition individuals have been seen in widely scattered localities in the territory. It is now one of the more common hawks in the area.

Buteo lagopus s. johannis (Gmelin): Rough-legged Hawk

On August 6, 1959, a specimen in typical plumage was seen along the road on the west side of Blue Sea Lake. It is the only one noted in the territory at any time.

Haliaeetus leucocephalus (Linnaeus): Bald Eagle

The Bald Eagle was never common but I have only seen one since 1942 and that was a single individual on July 15, 1958. It has not been observed in a much larger territory in recent years.

Pandion haliaetus carolinensis (Gmelin): Osprey

Only two Ospreys were observed since 1947, one at Blue Sea Lake on July 30, 1954, and another on August 6, 1959.

Falco sparverius sparverius Linnaeus: Sparrow Hawk

This species has become somewhat more numerous since 1949. It has been seen frequently with records of two to four individuals on one day. The highest daily count was on August 6, 1959.

Canachites canadensis (Linnaeus): Spruce Grouse

Two specimens taken near Forks Lake on August 1, 1950.

Tringa solitaria solitaria Wilson: Solitary Sandpiper

Two birds noted near Lapine on July 27, 1949.

Totanus melanoleucus (Gmelin): Greater Yellowlegs

One bird on a beach on Big Island on July 19, 1952.

Larus argentatus smithsonianus Coues: Herring Gull

Larus delawarensis Ord: Ring-billed Gull

The Herring Gull, which has been present each year in small numbers, has increased noticeably since 1955. The Ring-billed Gull was first recorded on August 25, 1953, when a single bird appeared on Blue Sea Lake. It was present in 1955 and 1957 and has been numerous each year since that time. The largest number of birds actually counted was 83 on one little island on August 24, 1959. This was a mixed flock with the Ring-bills greatly outnumbering the Herring Gull. Similarly sizable flocks were seen in that and subsequent years.

Zenaidura macroura (Linnaeus): Mourning Dove

A single bird was noted sitting on a telephone wire near Grand Remous on August 1, 1952.

Bubo virginianus (Gmelin): Great Horned Owl

A single horned owl was seen on the north side of Lake Baskatong on August 22, 1950, and again on August 1, 1952.

Strix varia varia Barton: Barred Owl

While Taverner's notes listed one as seen by R. M. Anderson in October 1922, this species was not noted again until 1957. I did not visit the area that year but a Dr. Fred Glenny reported that it nested on Big Island. Since that time it has been present every summer. Adults and young (sometimes as many as four) have been seen each summer. A young male was collected August 11, 1959.

Dryocopus pileatus abieticola (Bangs): Pileated Woodpecker

This species has become markedly more common and since 1950 has been regularly seen on the larger islands and adjoining mainland of Blue Sea Lake. It has also been seen frequently on the shores of other lakes in the territory.

Nuttallornis borealis (Swainson): Olive-sided Flycatcher

On August 1, 1949, one of two birds was collected west of Blue Sea Lake near Eagle River. Two were seen in the same area July 27, 1950, single birds on both August 20 and 21 near Lake Baskatong and others in the same area on July 31 and August 2, 1952. A single bird was noted on August 6, 1959, on the west shore of Blue Sea Lake.

Petrochelidon pyrrhonota pyrrhonota (Vieillot): Cliff Swallow

A good sized nesting colony of this regular summer bird was first discovered near Eagle Depot on July 27, 1950.

Perisoreus canadensis canadensis (Linnaeus): Gray Jay

Taverner's notes furnished the only records until I collected specimens near Lapine Depot on July 29, 1949. Since then I have several times seen them about Baskatong Lake and one bird appeared on Ellard Island on Blue Sea Lake on September 23, 1951.

Cyanocitta cristata bromia Oberholser: Blue Jay

Noticeably more numerous since 1950. It has been noted more regularly and in greater numbers.

Corvus corax principalis Ridgway: Common Raven

Recorded only once prior to 1951. Since then it has been seen on many occasions in Blue Sea Lake, Long Lake, and Lake Baskatong. On July 14, 1958, four were seen on Big Island and a similar number on Lake Baskatong on July 18 of the same year.

Sitta carolinensis cookei Oberholser: White-breasted Nuthatch

I collected one near Eagle River on August 1, 1949, and saw two others there the next day. One bird was seen on Big Island on August 23, 1953.

Telmatodytes palustris dissaeptus (Bangs): Long-billed Marsh Wren

I am able to add a second record of this bird as one was seen on the north end of Blue Sea Lake on July 29, 1959.

Sialia sialis sialis (Linnaeus): Eastern Bluebird

There has been a marked decrease in this species since 1950 with no records at all since 1953 in the territory normally worked. A few have been noted outside the area.

Sturnus vulgaris vulgaris Linnaeus: Starling

The Starling has occupied all the suitable area in the territory and is now a conspicuous and abundant species.

Vireo olivaceus (Linnaeus): Red-eyed Vireo

Found regularly in all suitable area but has been noticeably less numerous since 1953.

Vireo philadelphicus (Cassin): Philadelphia Vireo

Two recent records of this species were obtained on Big Island, one on August 31, 1953, and the second on August 26, 1960.

Mniotilta varia (Linnaeus): Black-and-white Warbler

Dendroica magnolia (Wilson): Magnolia Warbler

Dendroica caerulescens (Gmelin): Black-throated Blue Warbler

Seiurus aurocapillus aurocapillus (Linnaeus): Ovenbird

Setophaga ruticilla tricolora (Müller): American Redstart

The above warblers have all been noticeably less numerous on the islands and shorelines of Blue Sea Lake since 1949 and 1950.

Vermivora ruficapilla ruficapilla (Wilson): Nashville Warbler

Dendroica fusca (Müller): Blackburnian Warbler

Dendroica castanea (Wilson): Bay-breasted Warbler

These three species have become more numerous than the numbers of the preceding groups in the same habitats. The Nashville has increased since 1951, the Blackburnian since 1947, and the Bay-breasted since 1950.

Vermivora celata (Say): Orange-crowned Warbler

A single bird noted on the north shore of Lake Baskatong on August 23, 1950.

Dendroica tigrina (Gmelin): Cape May Warbler

A newly fledged juvenile was collected out of a group of four on Big Island on August 27, 1950, and two birds were seen on the same island on July 30, 1954.

Dendroica striata (Forster): Blackpoll Warbler

Two birds on Big Island on August 31, 1953, and others on August 26 and 28, 1955.

Wilsonia pusilla pusilla (Wilson): Wilson's Warbler

One on Big Island on August 25, 1960, the second record for the area.

Passer domesticus domesticus (Linnaeus): House Sparrow

Regularly seen about farm yards, towns and grain fields but in smaller numbers since 1950.

Agelaius phoeniceus phoeniceus (Linnaeus): Red-winged Blackbird

The noticeable increase in the breeding population of this bird seems to be due to the birds going into fields, the edges of thickets, and other previously unused nesting sites.

Molothrus ater ater (Boddaert): Brown-headed Cowbird

This bird has become fairly regular since it was first collected July 13, 1955, on Blue Sea Lake. It has been noted in most subsequent years. Taverner's notes furnished the only prior record.

Passerina cyanea (Linnaeus): Indigo Bunting

The Indigo Bunting is no longer present in the areas where it was formerly a regular resident. The progress of natural reforestation has changed the environment to the extent that the birds have abandoned it and are now found in other places mostly outside the area worked.

Hesperiphona vespertina vespertina (Cooper): Evening Grosbeak

The most striking change in the bird life has been the invasion of the Evening Grosbeak as a breeding species. Prior to 1949 I had a single summer record and one fall record.

On August 1, 1949, a single bird was noted in the village of Caymont on the southern corner of the area and on July 27, 1950, I saw two birds at Cedar Lake. On August 2, 1950, a number were seen near Forks Lake just north of Lake Baskatong. On August 20, 1950, a flock of ten were seen along the road near Lapine Depot and 10 or 12 were feeding about our camp near Forks Lake that afternoon. On August 22 about 25 grosbeaks, about 15 White-winged Crossbills and a number of Purple Finches were present apparently eating dirt near an old lumber camp cook shack. It is probable that sale or some other substance had been spilled there. On August 20, 1955, I watched a female feed a well-fledged young in Maniwaki and saw numbers in the same part of town on August 23, 1955. On August 21 one bird was near our cabin on Blue Sea Lake. Again on September 8, 1955, the street trees in Maniwaki held numbers of grosbeaks including several young that frequently begged for food. In 1956 and 1958 I was not in the territory long enough to make any extended field trips, in 1957 I did not get there at all and in 1960 I was able to observe only the birds I could see from the cabin or from a boat in Blue Sea Lake so my notes are confined to Blue Sea Lake itself in those years. On July 26, 1959, four birds were seen at the north end of Blue Sea Lake and three birds were present on the west shore on August 6. No grosbeaks were noted at either Maniwaki or the Baskatong although both areas were worked. In 1961 a part of the territory around Baskatong and all of the other parts of the area were worked without seeing any grosbeaks. The peak year of abundance according to my notes was 1955 but they could have been equally abundant in any of the three succeeding years when I was not able to do the normal amount of field work. Birds collected were of this race.

Loxia curvirostra Linnaeus: Red Crossbill

Four Red Crossbills were seen near Forks Lake on August 21, 1950. A group of four or more were noted from our cabin on August 27, 1959.

Loxia leucoptera leucoptera Gmelin: White-winged Crossbill

Several were collected and a flock of fifteen noted near Forks Lake on August 22, 1950.

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OCCURRENCES OF THE ORCHID *LISTERA AUSTRALIS* IN THE VICINITY OF QUEBEC CITY

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IN 1947, THE WRITER discovered a few plants of the Orchid *Listera australis* Lindl., in a small and shallow boggy area in Sillery, P.Q., a suburb of Quebec City. The entire bog was destroyed the next year by a housing development. The unexpected discovery, however, at least trained the eye to find this most inconspicuous plant and gave hope that the occurrence was not unique for the area. Subsequent visits to other areas within easy reach of Quebec City soon fulfilled this hope.

Listera australis appears to be quite widely distributed in the Quebec area, being found in a majority of the sites which seem to meet its habitat requirements. In this region the preferred habitat probably is acid peat bogs, but primarily those parts of the bog offering a rather specific range of microclimate. Since the following conclusions are derived from a limited number of observations, they are only tentative.

Plants were found growing amid living *Sphagnum*, with the root system buried to a depth of three or four inches, so that it lay in a zone of saturated, dead but undecomposed moss. The plants always occurred among rather thin growths of shrubs, primarily *Kalmia polifolia*, which would provide a little broken shade. They were not found in heavy shade. *Listera australis* seems to prefer very bright light. It is perhaps noteworthy that all the plants observed grew singly in open patches of *Sphagnum* at least two or three inches from the nearest shrub stems.

Although a very few specimens were found in completely open bog areas with no trees and only very short (six to eight inch) *Kalmias*, the majority of specimens were found along the southern or eastern edges of stands of Tamarack, *Larix laricina*, and Black Spruce, *Picea mariana;* or in open stands of these trees where inter-tree distances of ten to fifteen feet gave openings for the typical *Sphagnum/Kalmia* carpet to develop. Such zones would tend to have a more stable microclimate than the open bog through blocking of wind by the trees. They would also have a heavier winter cover of drifted snow. Either or both of these factors may be important to this *Listera*.

Since 1947, the writer has found *L. australis* at five distinct sites in the Quebec City region:

(1) Sillery, P.Q.—bog edge (now destroyed).

(2) South of Charny, P.Q.—edge of mossy woods.

(3) "Mud Lake" at Lac St. Joseph, P.Q.—floating bog.

(4) Small Arms Range, CARDE, Val Rose, P.Q.—bog.

(5) Ste. Catherine, P.Q.—large peat bog.

Advantage was taken of a short trip to Quebec City to examine the last two sites again in early June, 1962. The two sites are described below.

1 June 1962. Small Arms Range, Canadian Armament Research and Development Establishment (on the grounds of Valcartier Camp), Val Rose, P.Q.

This area is an extremely flat valley floor about a mile wide at the site of the bog. It was formerly the bed of a lake which disappeared when the Jacques Cartier River began to flow into the St. Lawrence. In 1947, except for some lanes cut for lines of fire and buildings for the small arms ranges, the whole area was covered by swampy and boggy woods of mixed composition but predominantly evergreen, particularly in the slightly lower and wetter areas which were semi-open bog. Except for much more extensive clearing nearby, the area is much the same to-day.

The topsoil is black or brown forest peat about one or two feet thick, overlying cross-bedded fine sand extending to bed-rock and with occasional patches of quicksand, gravel and erratic boulders. These last show only at the foot of the boundary hills and on their slopes. The sand is mostly quartz and feldspar with visible amounts of mica and magnetite. The surrounding hills are mostly igneous and igneous metamorphic rock, so alkaline drainage to the bog is minimal. In addition, the drainage systems appear to be along the base of the hills with local run-off only reaching the edge of the wet area.

The bog in which *L. australis* was examined is perhaps 100 yards by 50 yards in extent. It is a semi-open bog with scattered Tamarack and Black Spruce, and is bounded north and south by closed wet forest. The area is well-covered, *Kalmia polifolia* and *K. angustifolia* growing in a carpet of Sphagnum. The moss is wet but the footing is so firm that only after rain will anyone crossing it get wet feet.

Nineteen specimens of *L. australis* were observed in one hour. One plant had three flowers open, seventeen plants were in bud, and one had only leaves with no flower spike. A supernumerary leaf appears rather commonly in this species and is usually smaller and narrower than the main leaves; one of the specimens had this extra leaf.

At the time, the most conspicuous plants in flower in the bog were *Kalmia polifolia* and *Andromeda glaucophylla. Cypripedium acaule* was in the middle bud stage, a week or two from flowering. The most prevalent plant companion to the *Listera* was *Smilacina trifolia*, which showed only a few early flowers open. Nearby, both Painted Trillium, *T. undulatum*, and *Rhododendron canadense* were in full flower.

Since this site is on the property of the Department of National Defence (Defence Research Board), it is not accessible to the general public.

2 June 1962. Ste. Catherine, P.Q.

The Ste. Catherine peat bog is similar in origin to that at Val Rose, being on part of the same lake bed but several miles further west on the other side of the Jacques Cartier River. It is most easily reached by car by driving to the vicinity of the Ste. Catherine railway station and walking east on the railway embankment which runs longitudinally through the bog just north of its center.

This is a very large bog, several miles across in any direction. From the air it can be seen to be a predominantly open bog, with scattered groups of trees and a few patches of heavy wet woods, particularly along its edges. Drainage is radial, the bog being slightly domed. There are a large number of open ponds in somewhat parallel curvilinear patterns. These are predominantly in the western half of the bog, forming a typical ridge-bog structure. Since the actual bog is very shallow, only some of the ponds being overgrown by floating bog, it is possible to walk almost anywhere on its surface without going above ankle depth in water and to approach within a foot of the edge of most of the ponds.

In about one hour of searching, nine plants of *L. australis* were found, all in full flower. One specimen was in the open bog in low *Kalmia*–scrub about one hundred yards from the nearest trees. The other plants were at and among the southeast edge of a scattered group of Tamarack and Black Spruce.

Other plants in flower at the same time were those of the other site described except the *Smilacina* which was in full flower, not just beginning to bloom.

Living and pressed specimens of the *Listera* were taken for distribution to the herbarium of the National Museum of Canada and to the growing houses of the Canadian Department of Agriculture at Ottawa.

Observation of the living specimens indicates that, as seems to be normal in this genus, elongation of the main stem and floral axis continues until the fruits mature. The writer has seen individual plants in seed which were over seven inches high above ground. (The photograph of *L. australis* in Morris and Eames *Our Wild Orchids* is of a plant in seed.)

Knowledge of the life cycle of many of our orchids is fragmentary. The Department of Agriculture at Ottawa is starting a program for studying wild plants, including orchids, under controlled cultural conditions; so that we can hope for more information in a few years. The *Listera australis* plants now at the Experimental Farm were mostly in bud when collected. Arrangements have been made to exclude insects from the plants in order to learn whether this species is self-fertilizing.

Listera australis is commonly considered one of the rarest orchids in Canada, having been collected previously only from the Mer Bleue, Ontario (Fletcher 1893) and Ste. Dorothea, P.Q. (Mouseley 1940). These references are to herbarium specimens in the collection of the National Museum of Canada, Ottawa. From the experience of the writer, it is more likely that the species is simply overlooked far more often than not. The plants are very small, ordinarily grow in shrubby cover taller than themselves and, perhaps more important, blossom very early in the spring. By the time the bog flora becomes more spectacular and plant hunters more attracted to it, there is much more to distract a searcher. Careful attention to suitable habitat areas will probably result in wide extension of the recorded distribution of this species. I hope that the specific information given in this note will encourage field workers to search for *Listera australis* whenever possible, and to report their findings.

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A NATURAL HYBRID BETWEEN *VACCINIUM MYRTILLOIDES* AND *VACCINIUM BOREALE* ON CAPE BRETON ISLAND*

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TWO SPECIES OF DIPLOID lowbush blueberry occur in Eastern Canada (Hall and Aalders, 1961). *Vaccinium myrtilloides* Michx. occurs throughout the region except in Newfoundland. It is relatively tolerant of shade and typically grows in open woods and in commercial lowbush blueberry fields, especially those recently derived from woodland. *Vaccinium boreale* Hall and Aalders occurs in Newfoundland growing on exposed headlands and open barrens. It has been collected in northern Cape Breton Island in similar cold and exposed habitats. For the most part, the habitats of the two species are different as well as being geographically disjunct, and opportunities for hybridization have thus been rare.

In October 1961 we visited a commercial lowbush blueberry field at Frizzleton, Inverness County, Nova Scotia, and found the composition of the blueberry stand to be rather unusual. Although the tetraploid *Vaccinium angustifolium* Ait. was the dominant species in the field, *V. myrtilloides* and *V. boreale* were also growing there in considerable numbers. Since we had already crossed the two latter species in the greenhouse and had obtained hybrid progeny from them without difficulty, and since their flowering periods overlap sufficiently in the field for cross-pollination, we were anxious to see if hybrids occurred under natural conditions. A search was made for intermediate types and they were found sporadically throughout the area.

A comparison of the suspected natural hybrids with the artificially produced ones showed them both to be intermediate between the parents in general plant form and shape of leaf. *V. myrtilloides* typically has entire ovate to elliptical leaves with an obtuse base, and is strongly pubescent on both stem and leaves. *V. boreale* is much more branched and typically has glandular-serrate lanceolate to ovate leaves, often with oblique base, and has little or no pubescence. The naturally occurring plants were intermediate in stem pubescence, but resembled *V. myrtilloides* more closely in leaf serration. The artificially produced hybrids tended toward *V. myrtilloides* in stem pubescence and toward *V. boreale* in leaf serration. Chromosome counts showed that the naturally occurring plants were diploid (2N=24) as would be expected if they were hybrids of diploid parents.

The artificially produced F_1 hybrids were intercrossed and an F_2 generation of sixty-two plants was grown and studied. These were scored for plant form, stem pubescence, leaf serrations and shape of leaf, giving a value of 0 for a *V. boreale* expression, a value of 4 for a *V. myrtilloides* expression, and

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TABLE 1—SCORES FOR CHARACTER EXPRESSIONS OF 62 F_2 PLANTS OF THE CROSS *V. boreale* × *V. myrtilloides*

Character	No. of plants receiving a score of				
	0	1	2	3	4
Plant form	0	23	28	11	0
Stem pubescence	9	25	23	5	0
Leaf serrations	1	25	28	8	0
Shape of leaf	0	19	29	14	0

intermediate values for intermediate expressions. All of the F_2 plants were intermediate for at least two characters, and most were intermediate for all four characters (Table 1). The four scores were then totalled to give an overall value for each plant. The overall scores indicate that the F_2 progeny exhibited a continuous range of variation intermediate between the two parental species (Figure 1).

The plants growing at Frizzleton differed somewhat from the F_1 species hybrids in the expression of certain characters, but since they were within the range of variation of the F_2 plants, they may have been recombined one or more generations beyond the F_1. It is also possible that F_1 hybrids similar to the ones found at Frizzleton would have been produced if different parental plants of *V. boreale* and *V. myrtilloides* had been used in artificial crossing. There can be no doubt, however, that the intermediate type plants found growing with *V. boreale* and *V. myrtilloides* arose through hybridization between these two species. Similar intermediate type plants have been found in northwestern Quebec and have been named *V. angustifolium* var *integrifolium* Lepage (1951). Specimens of this taxon have been examined and they are undoubtedly also hybrid in origin. They indicate that the distributions of *V. boreale* and *V. myrtilloides* overlap sufficiently to allow hybridization in northwestern Quebec as well as in northern Cape Breton Island.

The two diploid species *V. boreale* and *V. myrtilloides* differ in several major genetic and morphological factors, are geographically separate, and grow for the most part in different habitats. Therefore, the fact that they can and do hybridize under natural conditions in no way nullifies their status as separate species.

Species hybrids growing under natural conditions have been found in many plant genera. Natural hybrids between *Vaccinium myrtillus* L. and *V. vitis-idaea* L. occur in Europe (Ritchie 1955a, 1955b), and hybrids between *V. angustifolium* and *V. corymbosum* L. occur commonly in eastern North America wherever the two species grow in close proximity. The hybrids between *V. boreale* and *V. myrtilloides* provide a further example of natural species hybridization within the genus.

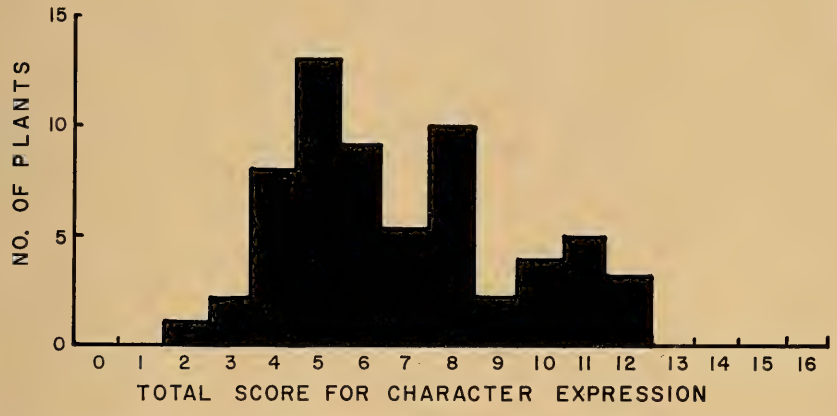

FIGURE 1. Frequency of total scores for character expression of 62 F_2 plants of the cross *V. boreale* X *V. myrtilloides*.

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NEW PLANT RECORDS FROM DISTRICT OF MACKENZIE, NORTHWEST TERRITORIES

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AMONG THE PLANTS collected in the District of Mackenzie during the 1961 Northwest Territories Botanical Expedition of Chicago Natural History Museum are specimens representing either unrecorded taxa from the area or significant extensions of known range. These records are summarized in this paper. The field work, which was made possible by a grant from the National Science Foundation, was carried out along the Great Slave Lake Highway from the Mackenzie River to Yellowknife. Unless otherwise noted, all specimens are in the herbarium of Chicago Natural History Museum (F), and the collection numbers are those of the author and his field assistant, Robert J. Reich. References to the few publications concerned with the flora of southwestern District of Mackenzie are listed by Thieret (1961) and need not be repeated here.

In the catalogue below, the arrangement of families is based on the Engler system. Specimens are cited by brief data to indicate locality and by collection number. Localities are given by miles either northbound from the Mackenzie River (e.g., mile 31 N) or southbound from Yellowknife (e.g., mile 16 S).

NAJADACEAE

Potamogeton pusillus L. Water 2 feet deep in creek, mile 7.7 S, *7816;* water 8 inches deep in roadside ditch, mile 13.2 S, *7860.* In District of Mackenzie previously recorded only from Norman Wells (Cody, 1960).

Potamogeton zosteriformis Fern. Shallow water in small lake, mile 36.4 S, *8351.* New to the flora of District of Mackenzie. Previously reported in the Mackenzie basin only in Wood Buffalo Park, Alberta (Raup, 1936). Our material is sterile. Mr. Ray Murdy, who also collected and observed *P. zosteriformis* in the area, was similarly unable to locate flowering or fruiting material.

GRAMINEAE

Glyceria borealis (Nash) Batch. In mud along stream, mile 20.5 S, *7893;* in mud in roadside ditch, mile 20.7 S, *7905.* Not previously reported from District of Mackenzie, although a collection from just south of the Northwest Territories-Alberta border near Fort Smith is cited by Cody (1957).

CYPERACEAE

Eriophorum gracile W. D. J. Koch. Among *Carex* at edge of small lakes, mile 35 S, *6741,* and mile 11.5 S, *7840.* First record for District of Mackenzie. Found in Alberta just south of the Northwest Territories border near Fort Smith (Cody, 1957).

Scirpus hudsonianus (Michx.) Fern. Marshy area at roadside, mile 86 N, *6878;* disturbed peaty soil at roadside, mile 110.7 N, *8134.* Previously reported in District of Mackenzie only from the eastern tip of Great Slave Lake (Raup, 1936).

Scirpus pumilus Vahl ssp. *rollandii* (Fern.) Raymond. In deposit of lake marl, mile 110.5 N, *7091.* New to the flora of District of Mackenzie. Previously known from the Gulf of Saint Law-

rence, from southwestern Saskatchewan, from Banff and Jasper, and from Colorado (Porsild and Crum, 1961).

JUNCACEAE

Juncus vaseyi Engelm. On mucky shore of lake, mile 16.5 S, *7882;* shore of Frame Lake, Yellowknife, *8344.* Previously reported in District of Mackenzie only at Fort Simpson (Raup, 1947).

SALICACEAE

All our willow collections were identified by George W. Argus.

Salix calcicola Fern. et Wieg. In black spruce-larch woods, mile 119.4 N, *7099.* New to the flora of District of Mackenzie. Said by Raup (1959) to be a "predominantly eastern American species" that is "common in places at Hudson Bay, but with a single western locality in the vicinity of Banff."

Salix pyrifolia Anders. "Bush" along overgrown roadway, mile 4.2 N, *6616;* peaty depression on granite outcrop, mile 4.7 S, *6703.* Previously reported in District of Mackenzie only in the southeastern corner (Raup, 1959).

CHENOPODIACEAE

Atriplex patula L. (typical) Disturbed peaty soil at roadside, mile 6 N, *8248;* waste place, mile 60 N, *8407;* disturbed clay, roadside, mile 8.9 N, *8427.* Typical *Atriplex patula* was previously unreported for District of Mackenzie, although a collection of var. *hastata* is cited from the Salt Plains near Fort Smith by Cody (1957).

Chenopodium rubrum L. Disturbed soil, mile 60 N, *8406;* disturbed soil, mile 75 N, *8396;* disturbed wet sand, mile 71.5 N, *8177.* New to the flora of District of Mackenzie.

CERATOPHYLLACEAE

Ceratophyllum demersum L. In 40 acre pond, mile 38.5 S, Murdy *132A* (in Herb. University of Southwestern Louisiana). New to the living flora of District of Mackenzie, although previously reported in fossil form (Terasmae and Craig, 1958). A single collection from Wood Buffalo Park, Alberta, was the only previous record for the Mackenzie Basin.

ONAGRACEAE

Epilobium angustifolium L. forma *spectabile* (Simmons) Fern. Disturbed sandy soil at roadside, mile 90 N, *7681.* New to the flora of District of Mackenzie. The flowers of our collection had pinkish white petals and reddish green sepals.

UMBELLIFERAE

Cicuta bulbifera L. Sedge zone around small lake, mile 12.7 S, *7859;* marshy area among willows, mile 45.5 S, *7948.* Previously reported in District of Mackenzie only at Norman Wells (Cody, 1960).

LABIATAE

Mentha arvensis L. (typical) Deposit of lake marl, mile 39.8 N, *7404.* Previous records of *M. arvensis* from District of Mackenzie are of var. *villosa* (=*M. canadensis* var. *glabrata*), distinguished by its lanceolate or lance-oblong, cuneate- or attenuate-based leaves. Of our nine collections of *M. arvensis,* eight are var. *villosa.* Number 7404, however, which has ovate to elliptic leaves rounded to their petioles, is clearly *M. arvensis* var. *arvensis.* Our specimens have the angles and sides of the stem equally appressed pubescent and so are forma *puberula.*

COMPOSITAE

Aster brachyactis Blake. Disturbed clay soil at roadside, mile 75 N, *8395;* in deposit of lake marl, mile 65.6 N, *8402.* New to the flora of District of Mackenzie.

Aster johannensis Fern. (duplicate determined by Arthur Cronquist) On *Calamagrostis*-dominated mucky shore of Great Slave Lake, mile 62.7 S, *8373;* among *Juncus* on shore of Great Slave Lake, mile 64.6 S, *8376.* New to the flora of District of Mackenzie. Previously

known in Canada only from Manitoba to southern Ontario and eastward (Scoggan, 1957).

Bidens cernua L. In mud along shore of Stagg River, mile 49 S, *8308*. Previously known in District of Mackenzie only from near Fort Smith (Cody, 1957). Our collection extends the known North American range of this species northward some 190 miles.

Tanacetum vulgare L. Weedy area on bluff overlooking Mackenzie River, mile 3.5 N, *8428*. New to the flora of District of Mackenzie.

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THE GLACIATION OF THE QUEEN CHARLOTTE ISLANDS*

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INTRODUCTION

THE QUEEN CHARLOTTE Islands which lie off the mainland coast of British Columbia were completely glaciated during the Pleistocene epoch. The glaciation is known to be that of the Wisconsin stage because of its freshness, the superposition of glacial sediments, and one Carbon 14 date. Evidence of earlier stages is either modified or destroyed, but the evidence of the latest glaciation is abundant, fresh, varied, and widespread. Nevertheless, biologists of many specialties have thought that these islands were either unglaciated, only partially glaciated, or unglaciated in the latest stage. In their view, problems of endemism and species distribution are best explained by a lack of glaciation. Statements by biologists have ranged from unqualified ones that the islands were unglaciated to carefully reasoned arguments that such must have been the case. The pervasiveness of the idea and variety of its adherents is partly shown by the following quotations.

1. "While there may be room for scepticism regarding the survival on Vancouver Island of a pre-ice age residual fauna, there can be no doubt concerning the Queen Charlotte Islands. Here there is no evidence of an overriding ice cap and the distinctive fauna, including such unique mammal species as *Rangifer dawsoni, Martes nesophila* and *Mustela haidoreum*, the races *Ursus americanus carlottae, Peromyscus sitkensis prevostensis* and *Sorex obscurus prevostensis*, together with well characterized races of Steller Jay, Pine Grosbeak, Hairy Woodpecker and Saw-whet Owl testifies to a long period of isolation. That part, at least, of this fauna is of preglacial or interglacial origin seems to be an inescapable conclusion." (McCabe and Cowan, 1945, p. 158).

2. "No evidence of glaciation is found at certain places, and it is further a possibility that existing biota have been derived from these areas of the preglacial land mass . . . If parts of the upland were not covered by the glacier complex, it seems reasonable to assume, in view of existing distributions, that plants could survive there and tolerate the rigor of the

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environment . . . [Langara] Island has a maximum elevation of 523 feet and shows no indication of having been glaciated." (Heusser, 1955. p. 442, 443, 447).

3. ". . . our field observations indicate that, although there was a limited alpine Pleistocene refuge on the summit of the Queen Charlotte Range, the lowlands seem to have been fully glaciated and there is no evidence any lowland plants persisted." (Calder and Saville, 1959, page 64).
4. "Langara Island and much of the Queen Charlotte Islands escaped glaciation." (Beebe, 1960, page 153).

The writers cannot judge the validity of the biological evidence and interpretation but they do wish to state the evidence of glaciation simply and unequivocally so that biologists will consider alternative explanations for the anomalies.

Geological Studies

Published geological works about the islands are few, most are old, and all with the exception of G. M. Dawson's (1880) refer but little to glacial features. Dawson visited the islands for 2½ months in 1878, travelling by a small sailing schooner in what was evidently a particularly poor summer. He had not the benefit of air photographs or road cuts. Nor did he climb any mountains. Moreover, his studies included the whole range of natural history. Nevertheless the number and accuracy of his glacial observations is remarkable and his general outline sound considering the limitations. Dawson (1880, p. 89B) summarized his observations in the following sentence, "We find everywhere in the Queen Charlotte Islands evidence of the descent of glacier ice from the axial range of mountains toward the sea, and little or none of the passage across the group of any more ponderous ice mass."

MacKenzie (1916) studied the bedrock geology of Graham Island and particularly the coal-bearing Cretaceous rocks, but his glacial observations were meager and largely incorrect. For example, he postulated that Yakoun Lake was unglaciated although roches moutonnées and striae can be observed on the very islands he cites as evidence. Furthermore the north end of the lake is dammed by a terminal moraine opening south that was formed at a late valley glacier stage. MacKenzie has been widely quoted by those looking to the geological literature to support their beliefs.

More recent studies also have been chiefly concerned with bedrock geology or mineral exploration. Holland and Nasmith (1958) studied the beach sands of Graham Island in connection with their black sand content. Sutherland Brown and Jeffrey (1960) issued a preliminary geological map of the southern part of the islands. Studies by the British Columbia Department of Mines and Petroleum Resources have been continued with a view to publishing a bulletin on the geology of the whole of the Queen Charlotte Islands.

FIGURE 1. A map of the Queen Charlotte Islands, British Columbia, showing the physiographic subdivisions and the localities mentioned in the text.

THE GLACIAL CONCEPT

The concept of a widespread ice age was first proposed in Europe by Louis Agassiz in 1837 less than forty years before Dawson's studies in the Queen Charlotte Islands. Agassiz originally believed that the ice sheet that covered much of Europe was an expansion of Arctic ice. It was not until the middle of the century that he recognized that continental ice masses originated as expansions of existing ice fields brought about by climatic change.

Glaciers form in regions of high snow precipitation and low melting rate where an accumulation of winter snow remains unmelted throughout the summer season and is buried by the snows of the following winter. The pressure of the load of succeeding annual increments of snow converts the snow to ice which then extrudes from the area of accumulation to some point below the snow line where the glacier melts. The position of the terminus of the glacier is determined by the equilibrium established between winter accumulation and summer melting. The glaciers expand or contract in response to changes in the pattern of precipitation and melting.

The onset of a major ice age is initiated by a radical change in climate which produces expansion of local mountain glaciers first through a stage of valley glaciers which then coalesce to form piedmont glaciers. The piedmont glaciers in turn build up to thicknesses which exceed the heights of the mountains which were the gathering grounds in the earlier stage of glaciation. The ice sheet then takes on the proportions of mountain ranges and profoundly influences the climate, perpetuating the ice sheet until a radical amelioration of climate brings about the decay and disappearance of the ice sheets, the piedmont glaciers, the valley glaciers, and in some places even the local alpine glaciers.*

Evidences of each stage of glaciation remain to confirm the existence and extent of the ice sheets during the ice age. The existence of former alpine glaciers in locations where they do not exist today is shown by cirques, erratic boulders, and striated and polished bedrock. The period of intensive valley glaciation in mountainous regions is marked by bold topographic features, such as glacially eroded U-shaped valleys and fiords, as well as roches moutonnées, striated bedrock, and erratic boulders. The period of piedmont glaciers is marked by all the foregoing features but in addition lineal features show converging trends in the mountains and a fanning out or diverging trend beyond the mountain front. The magnitude and extent of the ice sheet at its maximum stage is revealed by the distribution of glacial deposits and erratic boulders, by patterns of striations and grooving of bedrock and unconsolidated deposits, and by a softening of the topography of mountainous regions overridden by significant quantities of ice.

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*This sequence of stages is described in detail by Davis and Mathews (1944) and the interested reader should consult that paper.

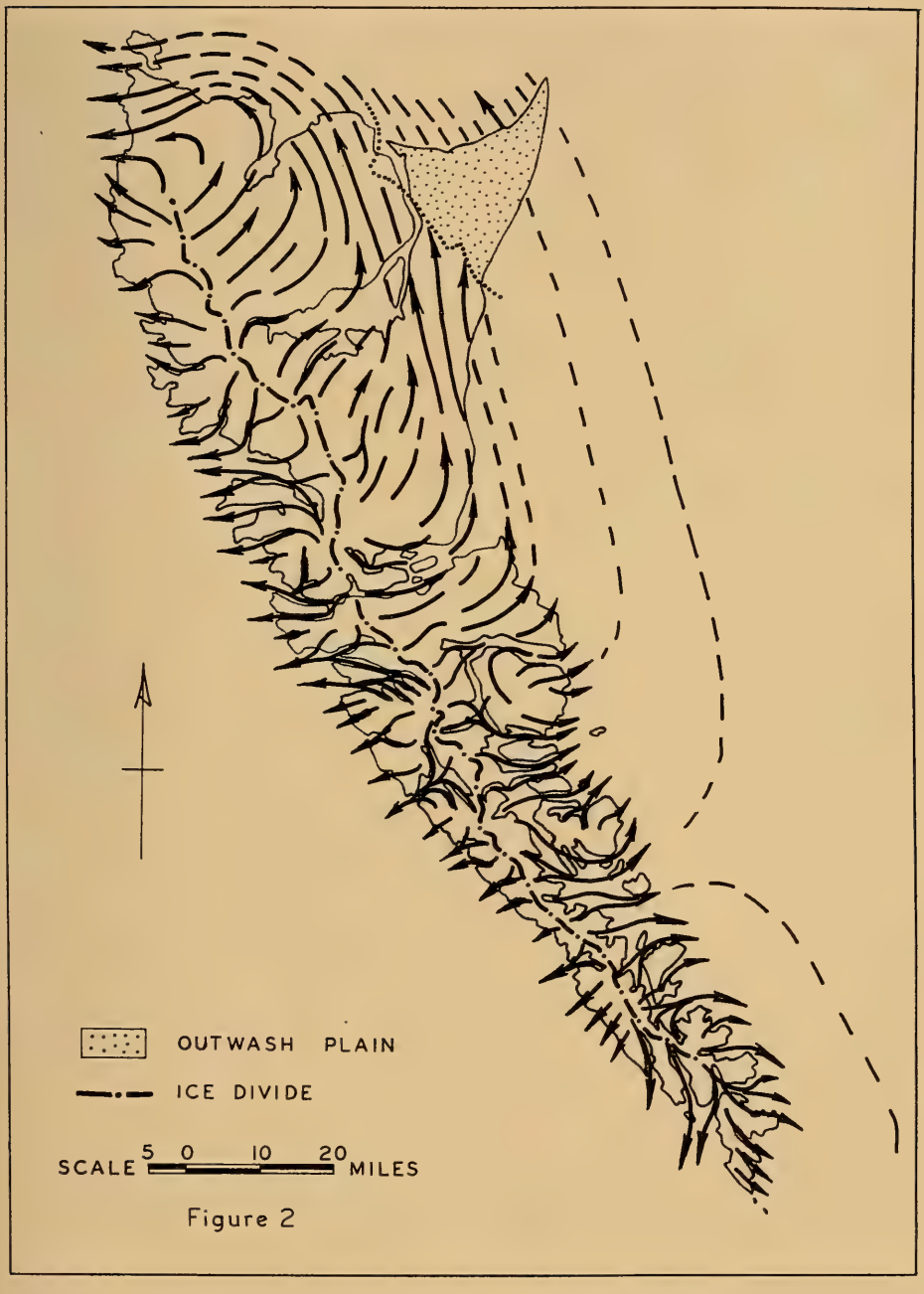


FIGURE 2. A diagram showing the direction of ice movement indicated by striae, roches moutonnées, flutings, and drumlins observed on the ground and on airphotos. An ice divide and late glacial outwash plain are shown.

EVIDENCE OF GLACIATION OF QUEEN CHARLOTTE ISLANDS

The Queen Charlotte Islands were completely glaciated. This is shown substantially by Figure 2 which illustrates the direction of ice movements indicated by glacial striae, roches moutonnées, flutings, and drumlins observed on the ground and on air photographs. Good examples of these features from widely separated localities are shown on Figures 3, 4, 6, and 7. In particular, Figure 3 is a mosaic of air photographs of Langara Island and vicinity and illustrates the intensely fluted and drumlinized character of this low area that has been said by biologists to be unglaciated. Almost certainly they have judged this area to be unglaciated because of the character of the shoreline where glacial features have been largely destroyed. A drop in sea level from a post glacial high about 25 feet above the present level has left a relatively wide zone affected by wave cutting. The limits of this cutting are clearly shown on the figure. In general, glacial features have only been completely destroyed along exposed sea coasts formed of poorly lithified, weak, or highly jointed rocks; elsewhere they are abundantly evident.

The surface of the Queen Charlotte ice sheet is judged by topographic features, erratic boulders, and striae to be about 3,000 feet. Peaks above 3,000 feet tend to be matterhorns with very steep slopes. They could have projected above the main ice surface as nunataks but would have been subject to a rigorous climate swept by gales and snowslides. Only 3.5 square miles of land surface are above the 3,000-foot elevation.

On the west coast the glaciers would discharge freely to the open sea and the idea might be entertained that between the glacier filled fiords there might have been unglaciated terrains. However, evidence of the level of the permanent snowline is given by the elevation of the floors of the lowest group of cirques and these are at or below present sea level. Therefore the only open ground might have been on some of the steep slopes which like the nunataks would have been subject to severe climatic conditions and swept by snowslides. Figure 10 shows a small cirque lake on the west coast near Kootenay Inlet which has its base below sea level. Similar cirques are well illustrated on maps of the National Topographic Series of the west coast, particularly sheets 103B/12 west, 103C/16 west, and 103F/2 east.

The ubiquitous distribution of glacial till further shows the complete glaciation of the islands. Lower slopes and hills in mountain and plateau regions are mantled by till from Kunghit to Langara Islands and the whole of the lowland is covered by it. Commonly two tills are evident with somewhat differing characteristics. At low elevations the lower till is rudely stratified and is evidently a stony marine clay to till. The tills are the youngest deposits except for outwash sands and gravels. In the triangular area from Masset to Cape Ball to Rose Spit the till is overlain by thick outwash sand and gravels deposited in an active stage during the general waning of the latest ice age. Figure 5 shows a thick section of Pleistocene deposits exposed on the shore near Eagle Hill in which two tills and overlying outwash sands are evident.

FIGURE 3. A mosaic of airphotos showing the intense fluting of Langara and adjacent Graham Islands. The Recent wave-cut bench on which glacial features have been destroyed is outlined and the approximate location is marked of a bog sample by Heusser from which peat at the bottom gave Carbon 14 age of 10,850±800 years B.P.

The pattern shown on Figure 2 indicates that all the ice traversing the islands was generated on them. The ice moved outward from an ice divide along the general height of land. The ice flowing westward probably formed a small ice shelf whereas that flowing eastward had a pattern impressed on it by contact with the ice sheet from the mainland. The natural flow of much of the Queen Charlotte ice would be to the southeast in the direction of the topographic gradient were it not in equilibrium with mainland-generated ice. The actual flow was toward the northwest except south of Burnaby Island. The vigour of the Queen Charlotte ice field was such that equilibrium was established well off the present shoreline and mainland ice was diverted seaward through Dixon Entrance and Queen Charlotte Sound. Major ice shelfs formed seaward of Langara and Kunghit Islands.

The age of the glaciation may be judged to be Wisconsin by the freshness of the erosional features, by the unweathered nature of the glacial deposits, and by the absence of significant overlying non-glacial deposits. This conclusion is confirmed by the one absolute age as yet available (Broecker and Kulp, 1957, p. 1325) which is quoted as follows:

> "Sample of limnic peat at a depth of 6.6 m in muskeg on Langara Island. Pollen profiles reveal a very early postglacial record. The sample should closely date the retreat of the Cordilleran ice from the ocean border. Submitted by C. J. Heusser. Age (yr) 10,850±800"

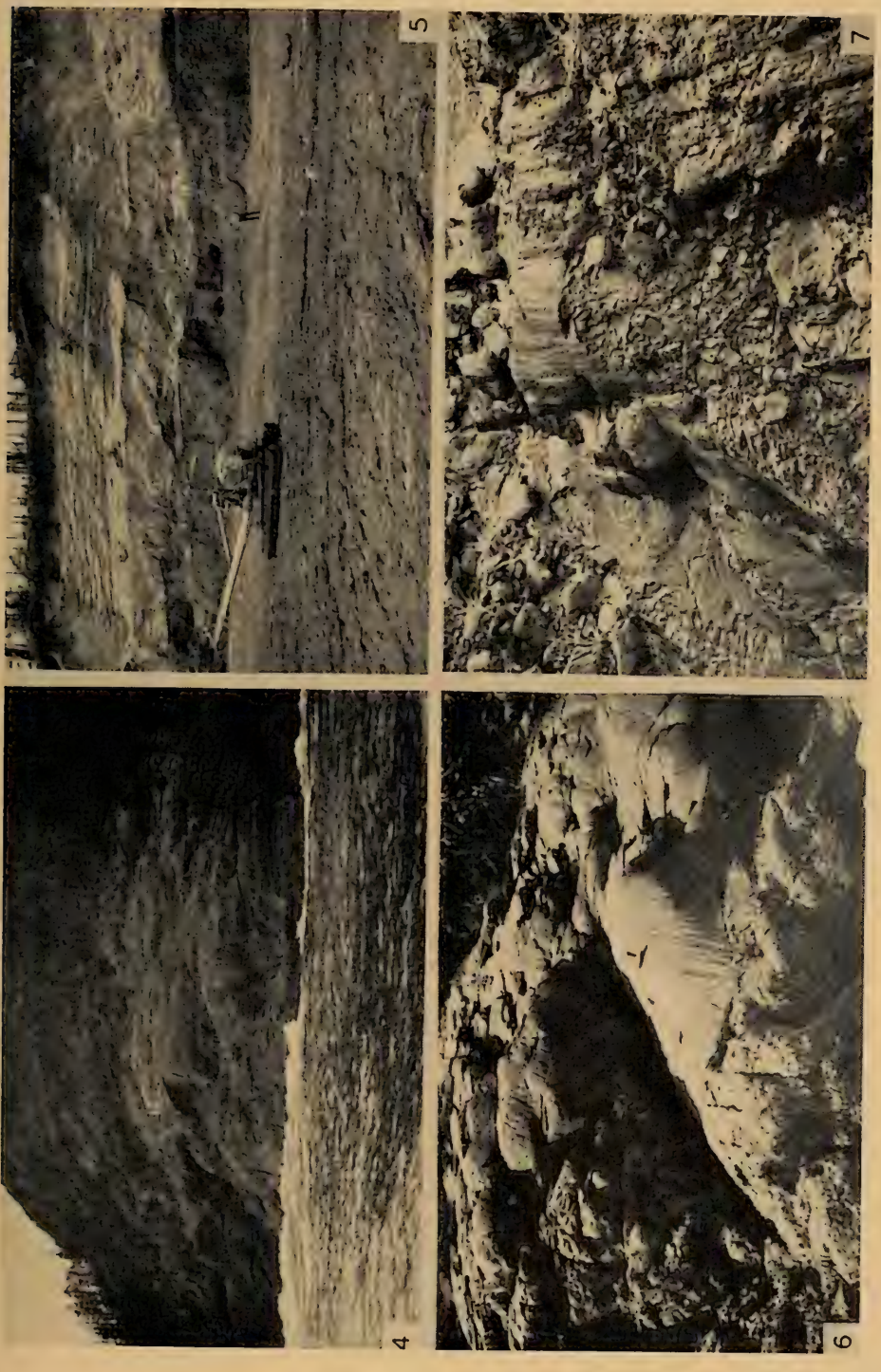
The approximate location from which this sample was taken is marked on Figure 3. The material is from the bottom of the organic part of the boring of a peat bog. Heusser (1955, p. 439) notes in regard to the portion from which the sample was taken. "This lower portion of Period I may be considered a late-glacial subdivision."

FIGURE 4. Glacial striations and grooves in rocks near the entrance to Tasu Sound are indicative of the intense glacial erosion produced by an ice tongue flowing out this channel. Glacial erosion is believed to be responsible for the deep fiords which indent the coast of both the mainland of British Columbia and the Queen Charlotte Islands.

FIGURE 5. A section of Pleistocene and Recent deposits exposed in a wave-cut cliff at Eagle Hill on the east coast of Graham Island consists of stony clay, till, and outwash sands and gravels typical of the glacial deposits found elsewhere along the British Columbia coast.

FIGURE 6. Glacial striae on rock surfaces at sea level on Anthony Island. Weathering rapidly destroys these features and clear examples are commonly found only where protective overburden has recently been stripped away. They were, however, observed in all parts of the islands.

FIGURE 7. Glacial grooves and striations on shales near Sandspit recently exposed and rapidly being destroyed by stream erosion in a small rill.



CONCLUSIONS

The evidence obtained from geological studies clearly indicates that during the Wisconsin period the Queen Charlotte Islands were buried by glacial ice. This ice was generated in the mountainous regions of the islands and flowed outward to join ice from glaciers in the coastal mountains. At the maximum stage of glaciation probably not more than 3.5 square miles of the land surface stood above the glacier ice and this small area was subject to severe arctic climate and swept by snow and rock slides to produce a most inhospitable environment.

Although details regarding the timing and sequence of glacial events are uncertain, a Carbon 14 date on material from Langara Island suggests that the islands became ice-free about the same time that the general retreat of glaciers was occurring throughout the rest of British Columbia and North America.

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FIGURE 8. An example near Pocket Inlet of one of the small matterhorns that may have projected above the Queen Charlotte ice sheet.

FIGURE 9. Erratic boulder of pillow basalt at Scaat Harbour typical of numerous glacial transported boulders observed throughout the Queen Charlotte Islands up to elevations of 2,000 feet. Subdued topography of the mountains in the background indicate that they were overridden by ice during the maximum stage of glaciation.

FIGURE 10. A view looking southwesterly toward entrance of Kootenay Inlet shows a small lake occupying a cirque basin. The present lake level is 115 feet above sea level and it is clear that when the cirque was being formed the local snow line was near present sea level.

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REVIEWS

Silent Spring

By Rachel Carson. The Riverside Press, Cambridge, Massachusetts. 1962. 368 p., illus. $5.95.

If you are a good citizen, farmer, biologist, gardener, fisherman, legislator, bird watcher, forester, doctor or a chemical producer, then you should read this book by one of the world's foremost scientific writers. It receives the reviewer's highest recommendation.

Silent Spring discusses the deletarious effects of chemicals used in the control of insects and weeds. Following the discovery of DDT, a host of control chemicals have come into the world: dieldrin, aldrin, endrin, the alkyl phosphates. More are being created. With the preliminary findings on the utility of certain chemicals in killing certain organisms, the miracle of modern industry and advertising systems have produced tons of these compounds which are being spread across the land by farmers, gardeners, as well as government agencies of all levels. It is only now that the disturbing side effects of these chemicals are coming to be known and that studies are being begun on the effects of the poisons on organisms other than those they were intended to kill. Many of the chemicals are highly toxic to man, many cause cancer or sterility. A single example of toxicity from the book will suffice: "In Florida two children found an empty bag and used it to repair a swing. Shortly thereafter both of them died and three of their playmates became ill. The bag had once contained an insecticide called parathion, one of the organic phosphates; tests established death by parathion poisoning." (Keep pesticides out of reach of children!).

Nor is it only the direct effects of these poisons which are to be feared. Spraying of spruce budworms in Canada has killed salmon and the invertebrates they feed upon. Spraying for Dutch elm disease has decimated the bird populations in many cities. They kill many other insects which are not only necessary to the balance of nature but also in the fertilizing of useful plants and trees. In many cases, control through chemicals is a crutch and not a cure. Respraying is required. Immunity to sprays has developed in several species.

Is this book a panicy negative attack by a nature lover? No! It is a carefully and elegantly written report by a noted biologist—the author of the book *The Sea Around Us*. Not only are the follies of chemical control pointed out, but alternate means of control are suggested. *Positive* as well as negative criticism is presented. Biological controls may be permanent, selective, inexpensive and leave no poisonous residues. This requires basic research into the lives of animals and plants. The female gypsy moth lures the male with perfume. Synthetic perfume can be used to trap or confuse males. Another new method is releasing infertile male insects with the consequence normal males are displaced and the female lays eggs which do not hatch. With this method houseflies were nearly wiped out from an island in only five weeks. The screw-worm fly has been *eliminated* from the southeastern states.

It is evident that chemical insecticides and herbicides must be subject to legislative control (just as much as in the field of medical chemicals, as has been

shown during the recent thalidomide cases). Proper labelling of containers as to toxicity, antidotes, and full precautions in use is required. Minimal levels of spraying on farm products for new chemicals need to be determined. Spraying of large areas of land should require permission from the departments whose resources will be effected—water, wildlife, fishery, forest and public health. To save one resource while endangering others is not justifiable. Certain chemicals might require withdrawal from the market. Further research is required on the effects of pesticides, by industry and/or governments. Now is the time for considered action to be taken.

While it may be expected that there will be resistance from the unenlightened portion of the chemical industry to ideas in this book, it is expected that the more advanced portion will modify their practices and take advantage of possibilities in biological controls. The same may be said of the organizations that utilize pesticides.

It is just as important to test pesticides for their long and short term effects on health as it is to properly test medicinal drugs. For the pesticides are sprayed on the food we eat, in the air we breathe and the water we drink.

Basic biological research, as well as increasing the fund of human knowledge, provides a well of information which can be drawn upon for practical application, such as biological control of pests.

Rachel Carson is to be commended for the excellent style in which this book is written and for the care she has taken in documentation. She is to be commended for her good citizenship in writing it. It is to be hoped that she wi'l be rewarded by a spring which is no longer silent but resounds with the carolling of birds.

D. E. McALLISTER
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The Saturday Morning Gardener

By DONALD WYMAN. MacMillan, New York 1962. 236 p.

This is not a book for the specialist who treasures his collections of irises, lilacs, roses and many of the other standard garden plants. The emphasis in this book is on easy maintenance. The author, Donald Wyman, is Horticulturist at the Arnold Arboretum, Boston, Massachusetts. He is a noted author of books on trees, shrubs and ground covers and of many articles on ornamental plant materials. In this book he has successfully approached the subject of gardening from a new and helpful point of view.

This is an up-to-date book containing not only the newest cultivars but also many newly introduced species of both herbaceous and woody plant materials. The author discusses not only trees, shrubs and ground covers but also perennials, bulbs, vegetables and fruits. Lawns are referred to, but not in detail. It is encouraging to see that many of the better native herbaceous and woody plants are recommended. Dr. Wyman has also gone into considerable detail on the latest labour saving materials for mulches, and chemical aids for the gardener. The author recommends against any plants which require time-consuming spraying, pruning, or other types of care. His observations, however, are often made because of troubles with plants in his area. These same problems do not always afflict the plants in other regions.

Many of the plants, as the author states, are new or rare in cultivation but these varieties of better quality must be recommended in books of this type if the gardening public is to be made aware of them. It is often only through repeated demands by the public that nurserymen will be persuaded to grow many of these newer or better, but often difficult-to-propagate varieties.

This book will be a definite aid to the Canadian gardener who does not want

to spend all of his free time in the garden weeding, spraying or pruning. However, as this book is written first for gardeners in the eastern and central United States those in the colder regions of Canada will not find many of their dependable ornamentals recommended, but only because there are many more plants to choose from in the milder climates. This book will, however, bring the gardeners of this country up-to-date on the latest in materials and plants for a low maintenance, yet attractive garden.

L. C. SHERK,
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Ottawa, Ontario

The Strange Lives of Familiar Insects

By EDWIN WAY TEALE. Dodd, Mead and Company, New York. 1962. 203 p., illus. $5.00 (Canada)

Edwin Way Teale has long been recognized as an enthusiastic naturalist and a writer with a talent for charming his readers. This talent is displayed again in his present book. It is by no means his best work, but it is nonetheless an enjoyable introduction to the world of the insects. What he says here has been said before in much the same way by other authors, but the Teale touch makes it somehow much more appealing.

The strange world of the insects is too large to be sampled easily and Mr. Teale has ventured to portray it mainly through the lives of some of its familiar inhabitants. The book is divided into three parts. Part I, "The Strangeness of Insect Life", introduces the theme with tales of oddities among the insects. Part II, "What Life is Like for an Insect", sketches the essentials of insect physiology. Here we are acquainted with how an insect is born and how it grows, sees, smells, tastes, breathes, communicates, etc. The final part, "Lives of Familiar Insects" is the main portion and is devoted to accounts of the lives of fourteen insects selected to represent some of the main orders of the phylum. Most of these insects, for example the may fly, cricket, house fly, and dragon fly, will be quite familiar to readers but the stories of their lives may come as something new and strange. Some of the other ones such as the cinch bug, lacewing fly, and cicada-killer wasp are perhaps less well known and their lives still more astonishing. The book is illustrated with twenty-six expert black and white photographs by the author and a series of charming drawings by Su Zan N. Swain.

Recent knowledge on some facets of insect life, for example the migrations of the monarch butterfly, have been overlooked or ignored by the author and his bibliography contains few references to new texts. However this does not detract seriously from the stories he tells and the book should appeal to any of Teale's many followers and to all who are curious about insects and wish to explore their lives more closely.

J. W. ARNOLD

NOTES

The Spread of the European Hare to the Ottawa Region of Ontario

THE SPREAD of the European hare *Lepus europaeus* in Ontario, to 1952, has been documented by Reynolds (1955, Canadian Field-Naturalist 69(1): 14-20). In 1912 seven hares are thought to have escaped from captivity about three miles south of Brantford, Brant County, Ontario. Since that time the species has successfully colonized much of southern Ontario. Reynolds (1955) recorded the most eastern specimen, known to him, from highway 38 near Hartington, Frontenac County, collected in 1948.

On January 14, 1961 Mr. Gifford Johnson, of Ottawa, shot a large brown hare that had been with a group of snowshoes rabbits. The specimen, now in the National Museum of Canada, is an adult male; total length 590 mm; tail 72 mm; hind foot 152 mm; ear 114 mm; NMC 28657, from 12 miles south of Ottawa, Carleton County. This specimen represents a north-easterly range extension of approximately eighty miles. During the winter of 1961-62 I received reports of several European hares in the Ottawa region and one road kill from five miles east-northeast of Ottawa was examined by me.

At present there are few European hares in the Ottawa district. However, a questionnaire kindly answered by twenty-seven Conservation Officers of the Ontario Department of Lands and Forests support these indications of a true easterly extension of range. Unsuitable environment probably limits much northern movement. The record from Burks Falls, Parry Sound County, reported by Downing (1948, Royal Ontario Museum of Zoology, Miscellaneus Publications 2:1-11) is far north of the present range of the species and was probably the result of an unsuccessful local introduction.

European hares are abundant and increasing in numbers in the area of Madoc in Hastings County, but swampland north of Mill Bridge has prevented further movement north. More northern distribution may, however, result from planned introductions by the cooperative efforts of the Bancroft Fish and Game Association and the Frankford Fish and Game Club.

Hares seem firmly established in the Gananoque-Lansdowne area in Leeds County and sightings have been reported a few miles north of Maitland, Grenville County and in the vicinity of Smiths Falls in Lanark and Leeds Counties.

If recent records and the records of Reynolds (1955) are plotted on a map it will be noted that the European hare has extended its range, in Ontario, approximately 300 miles easterly since 1912.

I am indebted to Conservation Officers, R. L. Ramsbottom, A. J. Ruxton, J. J. Thibadeau, C. D. Thompson, R. Lorne Irvine, E. W. Munro and E. E. Blackman for much of the above distributional information.

PHILLIP M. YOUNGMAN

National Museum of Canada
Ottawa, Ontario
17 May 1962

White-fronted Geese Breeding in the Thelon Valley, N.W.T.

CLARKE, (1940, National Museum of Canada Bulletin 96:1-135) saw only one flock of fifteen White-fronted Geese, *Anser albifrons* ssp., on the Thelon and concluded there was doubt whether this area should be included in the breeding range of the species. Kelsall (1952, *The Thelon Game Sanctuary, MS in files of* Canadian Wildlife Service) saw White-fronted Geese only on August 3 and 4 during a two-week canoe trip down the Thelon River from the Hanbury-Thelon junction to Beverly Lake. He observed eleven downy young in almost the exact area of our 1960 summer investigations. (As a matter of interest I might add here that Kelsall (*pers. comm.*) banded two of the eleven young White-fronts, one of which was shot near Winnipeg in 1955). Kelsall (*op. cit.*) records his doubt that White-fronted Geese were breeding along the Thelon to any extent.

Judging from the many broods of four to six downy young observed, the White-fronted Goose was an abundant breeder in 1960 in the area near our camp on the river. Our field camp was located on the shore of the Thelon River about 175 miles west of Baker Lake, in the Keewatin District, Northwest Territories. Barry (*pers. comm.*) noted at least thirty broods of White-fronts between Beverly and Aberdeen Lakes and in a small marshy area beside the Thelon River, ten miles west of the end of Beverly Lake, during an aerial census on August 22, 1960. Earlier, Snyder (1957, *Arctic Birds of Canada.* University of Toronto Press) also delineated both the Baillie and Back Rivers and Beverly Lake areas as known nesting grounds for the White-fronted Goose. Similarly, Mowat and Lawrie (1955, Canadian Field-Naturalist 69(3): 93-116) reported a brood of nine White-fronts at Beverly Lake on July 23, 1949.

There is no doubt, then, that in recent years the Thelon River area has gained considerably in importance as a breeding area for White-fronted Geese.

E. KUYT

707 Dufferin Avenue,
Saskatoon, Saskatchewan.
13 May, 1962

A Colour Mutant of the Yellow Perch from Lake Erie

A STRANGELY COLOURED yellow perch, *Perca flavescens*, has been forwarded to the R.O.M. (*Cat. No. 21833*) by Dr. H. Regier, Research Division, Ontario Department of Lands and Forests, Wheatley, Ontario. It was collected on June 4, 1962 by Wm. Krause on the west side of Pt. Pelee in a pound net set six miles north of the tip of the point. It was shipped frozen and on ice and arrived in a very fresh condition. When caught measurements were as follows: 6.7 inches fork length, 7.0 inches total length and 0.14 lbs. weight. It was three years of age. The general body shape of this individual was typical of a yellow perch. However, the ground colour was bright orange instead of yellow to yellow-green and there were no dark vertical bars.

Colour Description: An ektachrome slide was taken after the fish was thawed out in water and colour notes and a colour sketch were made immediately afterward.

The back, sides (to an irregular, wavy line below the lateral line) and top of head were a solid, bright, but transparent *orange*. The closest colour in the Villalobos Colour Atlas is 017-12° (Villalobos-Dominquez, C. and J. Villalobos, 1947. *Colour Atlas*, Buenos Aires, El Ateneo: 46 pp. + colour charts). The lower sides and ventral surface were milky white. There were, on the top of the head between the eyes and between the nares, patches of black composed of densely concentrated black speckles.

There was a black mid-dorsal line, from the occiput to the origin of the spiny dorsal, formed in the same manner. The remainder of the back and orange part of the sides were finely speckled with black. Some areas on the sides were darker as a result of the coalescence of many of these speckles. There were no vestiges, on the fresh unpreserved animal or after preservation in formalin, of the usual broad, dark green, vertical bars on the sides. The cheek and lower operculum were brilliant metallic-silver and very mirror-like. The upper one-fifth of the operculum was orange.

The first dorsal spine was black, subsequent spines had orange to yellow bases and terminal sections and were clear between. The first interspine membrance was totally black; the other membranes had a terminal band of black gradually decreasing in depth from the second spine.

The first ray of the soft dorsal was orange. The tips of all other rays were orange to yellow and speckled with black. The dorsal edge of the soft dorsal fin appeared to be black bordered as a result of the speckling on the rays. The orange on the last rays created the impression of an orange patch at the upper rear edge of the soft dorsal.

The rear edge of the caudal appeared black as a result of the fact that the tips of the rays were pigmented. The bases of the caudal rays were orange to yellow. Neither orange nor black pigment was present on the membrane of the caudal fin.

The pectoral fin rays had orange tips with black specks. The mid section of the first ray of the pelvic fins was deep orange. Otherwise the fin was clear.

The central third of each anal ray, from the second and excluding the last two, was bright orange. The membrane and remainder of the anal rays were clear. Where not pigmented with orange or black, the rays, spines and membranes of the fins were clear and transparent, not dusky.

The pupil of the eye was black. The upper crescent section of the white-of-the-eye was the same orange colour and speckled with black. The tips of the upper and lower jaws had patches of black pigment. The ventral edges of the preopercular and subopercular bones were typically serrated.

The fin formula was as follows: Dorsal fins (1) XIII (2) II 13; Anal II 7; Ventrals I 5; Pectorals 12.

After preservation in 10% formalin for two and one-half days, most of the orange pigment had disappeared leaving a colourless body with black speckles.

Except for colouration, this specimen is a typical yellow perch (*Perca flavescens*) and does not seem to indicate a hybrid condition intermediate between this species and any other. Only one individual of this kind was found in the catch and this form had never been seen before by Mr. Krause. It would then appear that this is a colour mutant of the yellow perch.

E. J. CROSSMAN

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Toronto 5, Ontario.
7 June 1962

Recent Additions to the Nipissing Region, Ontario, Bird-lists

THE SIGHT RECORDS of four new species of birds in the Pimisi Bay area, Long. 79° 01′, Lat. 46° 16′, represent a further eastward penetration of one species, a northward extension of range in two species, and a hitherto unmapped migration route for the fourth species.

On May 2, 1961, Doris McLaren of Rutherglen asked me to name a bird in her field whose singing was unlike anything she had heard before. Upon hearing it, I tentatively identified it as a Western Meadowlark, *Sturnella neglecta*.

Some time later, Dr. Szizz of the University of Toronto banded the bird and confirmed my identification. In 1962 this meadowlark returned to the same territory for the third consecutive year.

On May 13, 1961, I saw in the McLaren barn-yard a grey bird whose size and white markings on wings and tail identified it as a Mocking-bird, *Mimus polyglottos*. I observed it for about 10 minutes during which time it flew about the yard, sang from a fence post, and fed on the ground at no greater distance than I could plainly see its lemon-yellow irises. Previous well documented sight records of the species have been obtained by Hazel Petty who, on May 3, 1956, found a Mocking-bird along the shore of Lake Nipissing and, on May 9, 1957, observed another in the same vicinity for three days.

At a curve of the road running along Pimisi Bay, I came upon a large raptor-like bird on May 6, 1962 just as it was coming down to feed on a beaver killed by a car. At a distance of no more than 150 feet, the bird caught sight of me, veered awkwardly, flapping its huge wings to regain altitude, found a weak thermal updraft upon which it slowly soared skywards out over the lake. I had time to note the solidly dark plumage as well as the peculiarly pinkish-yellowish head with its hooked beak. Now soaring, the bird disclosed an evenly broad contour of the wings without marked bends or kinks, held at a distinctly dihedral angle to identify it as a Turkey Vulture, *Cathartes aura*. As the vulture returned once more to the beaver carcass, a Common Crow, *Corvus brachyrhynchos*, attacked it, giving me a good opportunity to compare sizes. But finding me still there, the bird soared aloft. As it coasted downwind out of sight, I caught fleeting glimpses of it through windows in the wispy clouds.

Just before sunset on May 15, 1962, my husband and I saw a flock of about 85 large honking snow-white birds with conspicuous black wing-tips flying south over Pimisi Bay. With little hesitation we identified them as Snow Geese, *Chen hyperborea*. The next morning three more flocks were seen flying southwards, giving a total of 215 Snow Geese sighted. Six days later, I came upon a lone Snow Goose feeding in a field. As I crept up within 100 feet of it, the bird took flight, circling into the wind low over my head to make positive identification doubly assured.

LOUISE DE KIRILINE LAWRENCE

Pimisi Bay, R. R. No. 1,
Rutherglen, Ontario
26 June 1961

A Range Extension and Behaviour Notes for the Banded Rudderfish in Nova Scotia

THE BANDED RUDDERFISH, *Seriola zonata* (Mitchill), is considered uncommon in Canadian waters according to recent publications (Bigelow and Schroeder, 1953, United States Fish and Wildlife Service, Fisheries Bulletin No. 74; Leim and Day, 1959, Journal of the Fisheries Research Board of Canada 16(4)). Only two specimens have been reported from Nova Scotia; a 1928 record from near Liverpool, and one from the Canso Causeway in 1955. The fish discussed here was seen in Louisbourg Harbour, Cape Breton County, in 1961 and extends the official northern range limit about seventy miles to the northeast.

Whether this paucity of reported specimens reflects the true situation is questionable when one considers the statement by Vladykov and McKenzie (1935, Proceedings of the Nova Scotia Institute of Science 19(1): 90) that the species "is quite well known" to Nova Scotia fishermen who see juvenile specimens around buoys and other floating objects during the summer season. The following account is therefore offered

because it represents a specific locality record and because of the observations made on the behaviour exhibited by this fish towards inanimate and animate objects at the surface and submerged.

During part of the field season of 1961, I was on loan from the Nova Scotia Museum of Science to the Acadia University Institute, and worked with a team of scuba divers on a preliminary archeological survey of the underwater relics of the 1758 Siege of Fort Louisbourg. It was during these operations that I observed a banded rudderfish and had opportunity to note its interesting behaviour underwater. At the time, the distinct banded pattern and its companionable behaviour towards the divers and their equipment, led to the assumption the fish was its better publicized relative, *Naucrates ductor*, the pilotfish.

The fish was first seen on August 24 at a sixteen inch white plastic buoy anchored about 400 feet offshore from what was the town waterfront of Fort Louisbourg in 1758. The buoy marked the corner of an area under survey. As four of us approached, we noticed an inactive fish, about eight inches long, beside the buoy. Our presence did not frighten the fish away and it merely darted beyond our reach when grabbed at and then circled back towards the buoy again. This behaviour was entirely new in our underwater experience. Before continuing the survey work, I mentally noted the colour pattern and proportions of the fish. The compressed body, pointed snout, six dark bands, and deeply forked tail with white tips agree with the juvenile banded rudderfish as described by Bigelow and Schroeder (1953).

The next afternoon, I encountered the same fish (or an identical one?) in the same area, and it stayed with me for approximately one hour. I had entered the water in full diving gear and swum diagonally across the corner of the cove to untie a survey line at that shore. Kneeling in three feet of water, I turned away from shore and was startled to find a banded rudderfish staring into my face mask. I changed my position several times and noted the fish kept orienting itself to stay at the same level as my face mask and in front of it. Whenever I reached towards the fish, it swam around to one side of my head out of my field of vision. At this point, I swam to an underwater sled and spent the next hour being towed by an outboard motorboat back and forth along the parallel lines of our survey grid, and the fish stayed with me the entire period. The sled with its diver presented a most unfishlike object. The sled consisted of an aluminum pipe frame with a joy stick that controlled the angle of two lateral bright yellow ailerons. During the survey sweeps, the depth varied from eight to eighteen feet and occasionally the sled was brought to the surface. In addition, the sled was stopped now and again to examine objects noted on the sea floor, and yet every time it stopped, the banded rudderfish would go coasting around in front of me into my field of vision. After one such stop, a small tuft of filamentous alga caught on the tow rope and as the sled again picked up speed, the fish darted in behind the waving seaweed and swam vigorously and steadily, now directly in line with my forward vision. A few moments later, I looked up and the alga had been swept away and the fish was again behind me. Unfortunately, the manipulation of the sled and searching the sea bottom for artifacts demanded all my attention and I could never determine whether the fish was following close behind my head or my feet. This tenacious association continued for an hour, then I dropped the sled and swam into shore. Swimming into the shallows, I suddenly rolled over and looked back and there, at mask level, was the banded rudderfish. It remained stationary staring into my face, until I stood up in the waist deep water and looked down on

it, whereupon it immediately turned and darted straight away from shore.

During the eighteen days of diving (June 26-July 2, August 16-26) in Louisbourg Harbour, *Seriola zonata* was observed only on August 24 and 25.

J. SHERMAN BLEAKNEY

Nova Scotia Museum of Science
Halifax, Nova Scotia
30 July 1962

Notes on New Brunswick Bats

DURING AUGUST and early September 1959, S. W. Gorham and D. H. Johnston (National Museum of Canada field party under the direction of Dr. Austin Cameron) collected mammals and birds in southern New Brunswick. Among the specimens collected were sixteen bats, one of these being a big brown bat, *Eptesicus fuscus fuscus*. The specimens were identified by Dr. A. W. F. Banfield, Chief Zoologist, National Museum of Canada. This specimen appears to be the first record of the big brown bat for the province of New Brunswick. Morris (1948, Journal of Mammalogy, 29(2): 168) states: "The big brown bat probably occurs in New Brunswick but there are no definite records". He stated that a specimen had been taken at Eastport, Maine.

The following is a list of the species collected: Big Brown Bat, *Eptesicus fuscus*, skin and skull, sex ?, (NMC 27731) collected by D. H. Johnston, September 4, 1959, near St. Andrews, N.B.; measurements 128-55-12, forearm 46, tragus 8 mm. Silver-haired Bat, *Lasionycteris noctivagans*, skin and skull, male, (NMC 27730) collected at Rusigornis, N.B., August 14, 1959. Besides the two records mentioned by Morris (1948) there is one specimen which is the property of the High School at Gagetown, N.B. Eastern Red Bat, *Lasiurus borealis borealis*, skin and skull, male, (NMC 27732) collected near St. Andrews, N.B. on August 26, 1959. Morris (1948) mentioned one definite record. Hagmeier (1957, Canadian Field-Naturalist, 71: 35) mentioned an identification from the vicinity of Long Lake, Tobique Valley, as the second record for New Brunswick. Three specimens were collected by a National Museum field party at St. Leonard, N.B. in 1957. Little Brown Bat, *Myotis lucifugus lucifugus*, thirteen specimens (NMC 27787-27799) were collected at St. Andrews, N.B. from August 25 to September 5, 1959. Hoary Bat, *Lasiurus cinereus*, a bat (almost certainly this species) was observed in flight on August 26, 1959, near St. Andrews, N.B. It was seen at dusk at a height of approximately forty feet. Morris (1948) mentioned a definite record from Grand Manan, N.B.

STANLEY W. GORHAM
DAVID H. JOHNSTON

National Museum of Canada
Ottawa, Ontario
30 May 1962

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